RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Vol. 70 FEBRUARY, 1958 No. 2

CONTENTS

INTRODUCTION OF THE CARMAN LECTURER. *C. Edgar Virden, M.D.* 157

THE TREATMENT OF CANCER OF THE BREAST. THE CARMAN LECTURE. *L. Henry Garland, M.B.* 159

IDIOPATHIC PULMONARY HEMORRHAGE WITH HEMOSIDEROSIS AND MICROCYTIC ANEMIA. *Ernest L. Schoeniger, M.D., Arthur S. Tucker, M.D., and Robert P. Bolande, M.D.* 191

THE MYELOGRAPHIC EXAMINATION OF THE FORAMEN MAGNUM. *Leonard I. Malis, M.D.* 196

METASTATIC LESIONS TO THE LARGE INTESTINE. *Russell Wigh, M.D., and Norah du V. Tapley, M.D.* 222

CHEST FILM FINDINGS IN NEONATAL RESPIRATORY DISTRESS. *Gunter Schultze, M.D.* 230

A COMPARATIVE EVALUATION OF THE NEWER CONTRAST MEDIA FOR EXCRETORY UROGRAPHY. *Maurice Tatelman, M.D., and Rainer S. Pakusch, M.D.* 238

SIMULTANEOUS ROENTGEN EXAMINATION OF THE URINARY AND BILIARY TRACTS WITH DUOGRAFIN. *Burton Garfinkel, M.D., and Nathan James Furst, M.D.* 243

ROENTGEN MANIFESTATIONS OF PULMONARY TUBERCULOSIS UNDER DRUG THERAPY. *Lawrence A. Davis, M.D.* 247

USE OF THE EYES IN X-RAY DIAGNOSIS. *Frank A. Riebel, M.D.* 252

WORK IN PROGRESS. 259

REPORT ON 1956 AMENDMENTS TO THE RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION (ICRP). 261

EDITORIAL: LEO G. RIGLER, M.D. *H. Milton Berg, M.D., and Harold O. Peterson, M.D.* 263

FORTY-THIRD ANNUAL MEETING. 266

ANNOUNCEMENTS AND BOOK REVIEWS. 272

IN MEMORIAM: EUGENE THOMAS LEDDY, M.D. 275

ABSTRACTS OF CURRENT LITERATURE. 277

RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

EDITOR
HOWARD P. DOUB, M.D.
Henry Ford Hospital, Detroit 2, Mich.

ASSOCIATE EDITORS
Leo G. Rigler, M.D.
Laurence L. Robbins, M.D.
Harold W. Jacox, M.D.

EDITORIAL ASSISTANTS
Marion B. Crowell, A.B.
Florence Roper Jeffery, A.B.

PUBLICATION COMMITTEE
Robert P. Barden, M.D., Chairman
William T. Moss, M.D.
John A. Evans, M.D.

ADVISORY EDITORIAL BOARD
Richard H. Chamberlain, M.D.
Harold Cummins, Ph.D.
Edith H. Quimby, Sc.D.
Arthur Purdy Stout, M.D.

GENERAL INFORMATION

Second-class mail privileges authorized at Syracuse, New York with additional entry at Easton, Pennsylvania. RADIOLOGY is published by the Radiological Society of North America as its official Journal. Publication office, 20th and Northampton Streets, Easton, Pa. Subscription rate $10.00 per annum. Canadian postage, $1.00 additional. Foreign postage, $2.00 additional. Single copies $2.00 each. All correspondence relative to business matters connected with the Radiological Society of North America and RADIOLOGY, or remittance for non-member subscriptions, should be made payable to the Radiological Society of North America and should be addressed to the BUSINESS MANAGER, DONALD S. CHILDS, M.D., 713 E. GENESEE STREET, SYRACUSE 2, NEW YORK. In requesting change of address, both the old and the new address should be given.

Dues to the Radiological Society of North America include subscription to RADIOLOGY and should be paid to DONALD S. CHILDS, M.D., SECRETARY-TREASURER, 713 E. GENESEE STREET, SYRACUSE 2, N. Y.

The rate for "want" advertisements for insertion in the Classified Section is 8 cents per word, minimum charge $2.00. Remittance should accompany order. Rates for display advertisements will be furnished upon request.

Inquiries regarding the program for the Annual Meeting of the Society for the current year should be sent to the President.

RADIOLOGY is published under the supervision of the Publication Committee of the Radiological Society of North America, which reserves the right to reject any material submitted for publication, including advertisements. No responsibility is accepted by the Committee or the Editor for the opinions expressed by the contributors, but the right is reserved to introduce such changes as may be necessary to make the contributions conform to the editorial standards of RADIOLOGY. Correspondence relating to publication of papers should be addressed to the Editor, HOWARD P. DOUB, M.D., HENRY FORD HOSPITAL, DETROIT 2, MICHIGAN.

Original articles will be accepted only with the understanding that they are contributed solely to RADIOLOGY. Articles in foreign languages will be translated if they are acceptable. Manuscripts should be typewritten double-spaced, with wide margins, on good paper, and the original, not a carbon copy, should be submitted. The author's full address should appear on the manuscript. It is advisable that a copy be retained for reference as manuscripts will not be returned.

Illustrations and tables should be kept within reasonable bounds, as the number which can be published without cost to the author is strictly limited. For excess figures and for illustrations in color, estimates will be furnished by the Editor. Photographic prints should be clear and distinct and on glossy paper. Drawings and charts should be in India ink on white or on blue-lined coordinate paper. Blueprints will not reproduce satisfactorily. All photographs and drawings should be numbered, the top should be indicated, and each should be accompanied by a legend with a corresponding number. Authors are requested to indicate on prints made from photomicrographs the different types of cells to which attention is directed, by drawing lines in India ink and writing in the margin. The lines will be reproduced, and the words will be set in type. Attention should be called to points which should be brought out in completed illustrations, by tracings and suitable texts. These instructions should be concise and clear.

As a convenience to contributors to RADIOLOGY who are unable to supply prints for their manuscripts, the Editor can arrange for intermediate prints from roentgenograms.

Contents of RADIOLOGY copyrighted 1958 by The Radiological Society of North America, Inc.

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

Vol. 70 FEBRUARY, 1958 No. 2

Introduction of the Carman Lecturer

C. EDGAR VIRDEN, M.D.

Ladies and Gentlemen: It is tonight my pleasant duty to introduce to you the Carman Lecturer for 1957, the twenty-second of a roster of distinguished scientists who have honored the name of Russell D. Carman and themselves been honored in presenting before this Society some of the results of their studies and experience in the field of radiology.

The present lecturer was born in Dublin and was graduated in medicine from the University College, Dublin, in 1924. He served his internship at Richmond and Rotunda Hospitals in Dublin, in 1923 and 1924, and came to Stanford University, San Francisco, to serve as a resident in radiology under Drs. W. Edward Chamberlain and Robert R. Newell. He rose from clinical instructor in medicine at Stanford University Medical School in 1929 to clinical professor in radiology in 1950, a position which he still holds. He has been radiologist at St. Joseph Hospital, San Francisco, from 1930 to date. He served as Commander in the Medical Corps, United States Navy, from 1942 to 1946. He is consultant in radiology to the United States Veterans Administration; Armed Forces Institute of Pathology, Washington, D. C.; U. S. Naval Hospital, Oakland, Calif.; Letterman General Hospital, San Francisco; U. S. Public Health Service, as a Director on the Consultant Tumor Board; and the Stanford Service, San Francisco Hospital, 1947 to date.

Dr. Garland has served many radiological societies as an officer. He was president of this Society in 1948. He is one of the founders of the Pacific Roentgen Society and has served as president of the California Academy of Medicine. He was president of the American College of Radiology in 1938. He has contributed over one hundred papers to various journals and has lectured widely before many societies throughout the United States and abroad.

These are only a few of his accomplishments.

Several months ago I wrote to Harry, asking if there were anything that he would like to have me mention in this introduction, and I received this reply: "Dear Spike: Enclosed are some of the gory details—Hobby: skiing, 2nd place, U. S. National Downhill Ski Race, Veteran's Class, 1957; 1st place, Doctors' Open Ski Race, 1957, Edelweiss, California. Dilettante, tennis, color photography, and water skiing."

It is a pleasure to bring Dr. L. Henry Garland to the rostrum to deliver the Carman Lecture on "Treatment of Carcinoma of the Breast."

L. Henry Garland, M.D.
Carman Lecturer

The Treatment of Cancer of the Breast

The Carman Lecture[1]

L. HENRY GARLAND, M.B.

"The first and wisest of them all professed
To know this only, that he nothing knew."—(Milton)

THE DISTINGUISHED Canadian, in whose honor this lecture has been established, was graduated from the Marion Sims College of Medicine in the same year as that in which roentgen therapy was first reported by an American, G. W. Hopkins (39), as being apparently curative in mammary cancer. The year was 1901. Two years later Russell D. Carman was appointed instructor in surgery at St. Louis University Medical School, and seven years later he was placed in charge of actinography at Washington University School of Medicine (69). In 1913 he was appointed in charge of the Section of Roentgenology at the Mayo Clinic, and from that institution continued to expand his leadership in radiology, in clinical investigation, and in contributions to the organizational phase of his specialty. The scope of his leadership, infused with a genial and warm personality, has been so well delineated by previous Carman lecturers that I will not dilate further on the theme at this time, but merely refer you to the wellsprings published in our journal some 15 years ago (10, 13).

That I am deeply honored to have been invited to address you is obvious—an appreciation tempered, however, by the knowledge of my own inadequacy to do justice to the honor as well as to the difficult topic chosen. But recent developments in the understanding of treatment of cancer of the breast and its acknowledged importance may perhaps excuse the effort.

Being an accessible tumor, cancer of the breast was one of the first malignant diseases for which roentgen therapy was used. The initial reported case was that of Gocht (31), published in Germany in 1897; the first reported use in this country was by the aforementioned Hopkins who recorded successful results in 2 cases. Two years later Pusey and Caldwell (62) published their monograph on roentgenology, recording 25 successive cases; Pusey was probably the first person to advocate routine prophylactic postoperative irradiation for carcinoma of the breast, which he began in June 1901 at the suggestion of Dr. T. A. Davis of the University of Illinois (60). Thus, even before Carman had left St. Louis to go to Rochester, there were a number of publications dealing with this important problem.

A half century elapsed and then we read in Haagensen's admirable recent text (33):

> "It is only during the last decade that irradiation has begun to compete seriously with surgery as a method of attacking primary breast carcinoma locally. The results . . . warrant serious consideration of irradiation as a primary method of treatment. It is also only recently that surgeons in general have begun to be aware of the unsatisfactory results of the surgical attack upon carcinoma of the breast when surgery is used indiscriminately. These two factors, the recognition of the efficacy of irradiation, and the realization of the poor results of indiscriminate surgery, have created a dilemma in the minds of many physicians as to the correct choice of primary treatment for breast carcinoma.
>
> "The choice of surgery or irradiation is an exceedingly complex matter. It depends not only upon which is the more successful method of treatment as measured by cure and survival rates, but upon the penalty the patient pays in morbidity, the availability of the two methods of treatment, and finally upon their financial cost. I have no illusion that it is possible in view of all these complexities, and the incompleteness of our present knowledge of breast carcinoma, to say boldly what is the best treatment

[1] Presented at the Forty-third Annual Meeting of the Radiological Society of North America, Nov. 17–22, 1957.

Fig. 1. Roentgen irradiation for cancer of the breast, New York City, 1902. (From Portmann, U. V.: Science of Radiology, courtesy Charles C Thomas, Publisher, Springfield, Ill.)

for all primary breast carcinomas. I do believe, however, that I can present evidence that for certain well defined types of the disease certain methods of treatment in my hands are preferable."

This, too, is my task this evening.

CURRENT STATISTICAL DATA

From material provided by the National Office of Vital Statistics, the present age-adjusted incidence, prevalence, and mortality of female mammary cancer is estimated to be approximately as follows:

(*a*) *Incidence* (*i.e.*, number of cases first diagnosed in a given year): 72 per 100,000 females.

(*b*) *Prevalence* (*i.e.*, number of persons known to have that type of cancer during a given year): 110 per 100,000 females.

(*c*) *Mortality* (*i.e.*, number of persons recorded as dying of that type of cancer during a given year): 23 per 100,000 females (21).

Levin (44) estimates the probability of breast cancer developing in women from birth on to be about 5 per cent. Total deaths attributed to breast cancer were approximately 20,000 in the U. S. in 1950, or almost 10 per cent of all cancer deaths, male and female combined.

There is some debate as to whether the incidence of the disease is increasing. Lombard (47), Willis (77), and others do not believe that such is the case. The following mortality data kindly provided by the California State Department of Health (12) suggest that this may be correct:

TABLE I: DEATH RATES FROM CANCER OF THE BREAST 1910–1954

Year	Death Rate			
	Crude		Age-Adjusted	
	United States	California	United States	California
1910	16.2	16.1	20.4	19.0
1920	15.5	22.9	19.3	23.9
1930	18.7	27.4	21.6	26.5
1940	23.6	33.2	23.6	27.9
1950	25.0	29.7	22.5	25.2
1954	25.6	27.0	22.6	23.7

NOTE: Rates are per 100,000 total female population. The indirect method of adjustment was used, with United States 1940 rates taken as the standard.

It is to be noted that, while the crude rate shows a striking increase, both locally

and nationally, the age-adjusted rate does not. The United States rates are affected by the fact that not all states were included until 1933. Those excluded were in the southeast section, where cancer rates, for some unknown reason, are lower than for the rest of the country. This explains the differences between the rates for the United States and California in the earlier decades.

On the other hand, the World Health Organization reports that the trend of mortality from breast cancer *is* increasing steadily. Data from six representative countries (England, Scotland, Denmark, Netherlands, Switzerland, and Australia) show an increase from a mean rate of about 14 per 100,000 females in 1900, to 35 per 100,000 females in 1950. The rates are notably higher in England and Wales than in the United States (45).

It is of interest that, while there is some debate concerning the increase in United States breast cancer death rates, the reported rates from cancer of the uterus, stomach, and liver have decreased to a significant degree (while that from cancer of the ovary has doubled in recent years):

TABLE II: AGE-STANDARDIZED* CANCER DEATH RATES BY 5 MAJOR SITES, WHITE FEMALES U. S., 1930–1953

	1930	1935	1940	1945	1950	1953
Uterus	27.7	26.8	25.4	24.7	19.2	17.4
Breast	21.6	21.6	23.1	22.5	22.0	22.4
Intestines	12.6	13.5	14.4	16.5	13.5	13.8
Stomach	21.7	18.8	15.0	12.8	9.4	8.6
Ovary	3.6	4.7	5.6	6.0	7.1	7.3

* Standardized to 1940 U. S. population. Source: National Office of Vital Statistics and Bureau of the Census, Courtesy American Cancer Society.

Breast cancer death rates increase relentlessly with age, showing but a slight decrease in the curve during the menopausal decade. The rate is about 20 per 100,000 females at age forty and 150 at age eighty.

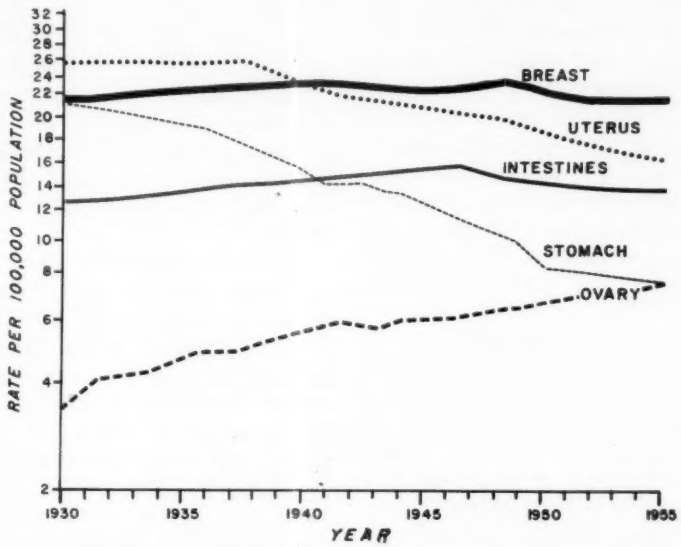


Fig. 2. United States white female cancer death rates, five selected sites, 1930 to 1955. (Courtesy American Cancer Society)

Several curious facts about breast cancer which were once speculative are now apparently well substantiated (47, 33, 72).

(*a*) Cancer is noted more frequently in the left than in the right breast (ratio 110 : 100).

(*b*) It is more frequent in the outer quadrants of the breast than in the inner (ratio 2:1), presumably because there is a greater volume of mammary tissue laterally.

(*c*) It is more frequent in women who

have *not* borne children than in those who have.

(*d*) It is reported more frequently in those who have never suckled their children.

(*e*) Bilateral simultaneous cancers occur in about 0.5 per cent of female breast cancer patients; and bilateral successive cancers in about 2.5 per cent (23, 33).

(*f*) The ratio of female to male breast cancer is roughly 100 to 1.

PATHOLOGIC CONSIDERATIONS

Breast cancer is believed to originate, in a majority of cases, as a local focus in one breast and is seldom diagnosed until at least several millimeters in diameter. Budd (11) believes that it arises "through a series of transformations in hyperplastic foci," so that the point at which carcinoma can be said to exist may be extremely difficult to define. Most patients have tumors over 20 mm. in diameter when first detected—tumors which are therefore several months or years old, and which are seldom still localized to the breast.

The growth rate of the primary mass of cancer cells is regarded by Lees (43) as probably logarithmic. "Once the cancer starts to infiltrate, even although its apparent rate of spread is slow, emboli are being thrown off. If the host still has a high degree of control, none of these emboli will take. When the primary cancer achieves a certain volume, however, the partial control over the neoplastic cell diminishes and metastasis may take." This, of course, is purely speculative.

The histologic classification of breast tumors is still a subject of debate amongst pathologists. Willis utilizes this simple grouping of epithelial breast tumors:

1. Fibroadenoma and adenoma.
2. Ductal papilloma and cystadenoma.
3. Carcinoma.
4. Paget's disease of the nipple.

According to Stewart (73), Ackerman (2), and others, the following tabulation represents the general distribution of primary *malignant* breast neoplasms by histologic type. Carcinoma is reported to predominate over sarcoma by a ratio of approximately 99 to 1.

	Percent
I. Carcinoma	
A. Intraductal	5
B. Infiltrating	
Papillary	4
Colloid	4
Medullary	4
Carcinoma, type unspecified	75
C. Rare types (apocrine, squamous-cell, adenocystic, pseudosarcomatous)	2
D. Paget's disease of the nipple	2
E. Inflammatory carcinoma	3
II. Sarcoma	
A. Malignant cystosarcoma phylloides B. Miscellaneous sarcomas	1

With the above classification, Haagensen (33) does not quite agree. However, his percentage finding of the main types, such as Carcinoma Unspecified, Paget's Disease and Inflammatory Carcinoma is almost identical.

Opinions of pathologists vary widely regarding the feasibility and utility of histologic grading of mammary cancer. Some recommend a combination of grading and staging (9). Haagensen provides rather convincing evidence in support of his belief that histologic grading gives useful prognostic information even in Unspecified Type tumors.

Figure 3 (upper curve) shows the survival rates in 766 patients seen at the Presbyterian Hospital (New York) prior to 1942 (as given by Haagensen), of whom about two-thirds had axillary metastases. Grade I lesions had a good prognosis, Grade III a poor one. Bloom (9) has published very similar findings (lower curve).

Stewart (73) prefers to base prognosis on the anatomicohistological type of cancer; he considers the fact that a tumor is circumscribed or papillary to be more important than the degree of anaplasia. Appropriate anatomical and histological classification therefore obviates the need of grading, in his opinion.

My personal experience in practice has been that the reported histologic type or

grade usually has had only moderate bearing on the clinical behavior, prognosis or radiosensitivity of the individual tumor. The "growth potential" and the clinical extent of disease at time of treatment are the paramount factors. The former can only be guessed at; the latter is determined with fair reliability.

be readily differentiated by competent pathologists.

BIOLOGIC CONSIDERATIONS

The malignancy of breast cancer varies widely. While the mean duration of life from first symptom to death in untreated cancer is about three years, cases are on

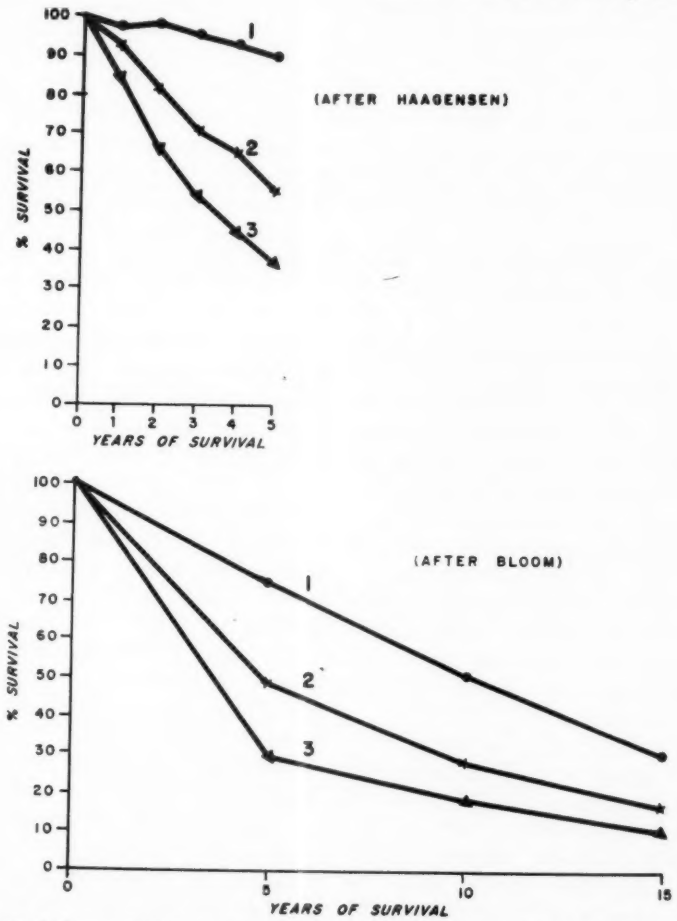


Fig. 3. Influence of histologic grade of primary tumor on survival of treated patients. The numerals above the curves indicate the *histologic grade* of the tumors.

Willis (77), Lees (43), and others discuss the reliability of pathologic diagnosis of mammary carcinoma and note that sclerosing adenosis is often mistaken for such. Grossly, sclerosing adenosis, chronic cystic disease, fibroadenomatosis, and fat necrosis all may resemble carcinoma. Microscopically, however, most cases are reported to record in which death from cancer occurred in three months (38), and again not for thirty-five years (19). The true duration of the disease is, of course, much longer than the apparent one.

The duration from first symptom to diagnosis is reported to be, on an average, about twelve months. There is only

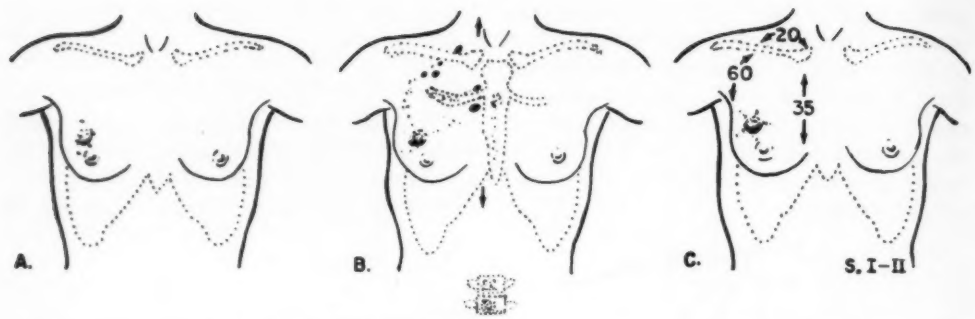


Fig. 4. A. Classical concept of a Stage I case of primary breast cancer. A solitary tumor in the breast is envisaged.

B. Actual status in many "primary operable cases." Note that there are lymphatic spread to the supraclavicular region, and vascular spread to the ribs, sternum, and lumbar spine. This situation is present probably in 30 per cent of primary *operable* cases and in about 55 per cent of an unselected group of patients with primary untreated breast cancer. This fact explains the inability of either radical surgery or radical radiotherapy to cure in a majority of patients.

C. Approximate percentage of positive metastatic nodes found in primary operable cases (Stages I to II), tumors of all quadrants considered as a group. At least 60 per cent of such patients are found to have positive axillary nodes, 35 per cent internal mammary nodes, and 20 per cent supraclavicular nodes.

modest correlation between apparent duration and tumor size. Bloom (9) and Haagensen (33) report decreased survival if patients with well differentiated (Grade I) tumors delay more than a month in coming for treatment after a lump is first noted, but found no significant decrease with delay in moderately or undifferentiated (Grade II or III) tumors. Prompt treatment gives demonstrably better results only in the Grade I lesions. Why? Presumably because the other two types had already spread long before the patient was aware she had a tumor.

Spread: The spread of breast cancer was once considered to be predominantly *via* the axillary lymphatic route. This was the basis for the operation perfected by Halsted and Willy Meyer. Recent investigations have shown that spread occurs by many routes—sometimes long before the parent tumor is detectable. Spread may be by direct extension, by lymphatic embolization (and, later, permeation), and by vascular embolization.

Direct extension occurs through the tissue spaces in the breast, especially the fatty tissues, and the muscles of the chest wall.

Lymphatic spread occurs *via* many pathways, including the subareolar and subcutaneous plexus of lymphatic vessels, the main axillary trunks, the pectoral group, and the internal mammary chain. There are also the inferior (or epigastric) lymphatics, the perforating lymphatics of the chest wall, and the subcutaneous channels to the opposite breast and axilla (Price, 61). The axillary, pectoral, and internal mammary groups drain into the nodes which ultimately empty into the subclavian vein. Involvement of these latter nodes is therefore usually associated with embolic venous spread—and radical procedures of any type will not be apt to cure.

Vascular spread occurs through the mammary veins to the axillary and supraclavicular veins, through the internal mammary veins, and through the intercostal veins (these last emptying into the azygos vein and also connecting with the vertebral venous plexuses).

The importance of the internal mammary chain of nodes and the vertebral plexus venous route has been appreciated only since 1949 and 1940, respectively. Handley (35), Andreassen and Dahl-Iversen (5), and others (33) have shown that about 40 per cent of "operable" patients with involved axillary nodes have "positive" internal mammary nodes; and that

about 10 per cent of "operable" patients with negative axillary nodes also have "positive" internal mammary nodes. Further, over 20 per cent of "operable" patients have "positive" supraclavicular nodes.

Batson[2] (8) showed how freely the mammary veins communicate with the valveless venous channels of the ribs, spine, pelvis, and skull. Tumor emboli thereby rapidly reach lungs, bones, liver, and other viscera. Gil (30) reported, and Ackermann (3) confirmed, the frequent finding of cancer emboli by sternal or vertebral body puncture in many clinically early cases. Engell (22) discusses the import of such in his monograph.

Size of Primary Tumor: The relationship of *tumor size* to degree of spread has been studied by many authors. In Haagensen's material, axillary metastases were found in about 58 per cent of his patients with tumors 1 to 3 cm. in diameter, in 68 per cent of patients with tumors 3 to 7 cm. in diameter, and in 78 per cent of patients with tumors over 7 cm. in diameter. Macdonald (48) reported that axillary metastases were found in 56 per cent of his patients with tumors less than 1 cm. in diameter. Bloom noted that size was of less importance than histologic grade in anaplastic and in well differentiated lesions. In lesions of intermediate grade, however, there was a correlation—small tumors yielding twice as many five-year survivals as large ones (small being defined as less than 1 inch in diameter and large more than that).

[2] "With the fluoroscope, I had watched a roentgen-opaque mass injected into a small venule in the breast travel by way of the superficial breast veins along the body wall through the axillary and cervical veins. Some of the mass went into the superior vena cava, but, much more interesting, the mass ascended along the vertebral veins into the blood sinuses of the cranium. . . . The skin of the body wall, including the breast, has many veins without valves. The direction of flow in these vessels is largely a matter of chance.

"It would be expected that tumors . . . in any of these structures having access to this valveless network could be distributed anywhere along this network. Of course, the ultimate directional flow is toward the heart and the secondary lesions could be in the lung. The point is that they need not be in the lung, since the vertebral vein system bypasses the portal, the caval, and the pulmonary systems." (Batson)

Location of Primary Tumor: The relationship of *tumor location* to spread is one of considerable variation. About 36 per cent of primary operable breast cancers are found in the *inner* quadrants and the central (subareolar) zone of the breast. About 64 per cent of primary operable tumors are located in the *outer* quadrants, notably the upper one. It has been reported by Handley (35), Urban (74), and others (33) that internal mammary lymph node metastases occur with operable tumors of the inner quadrants in about 56 per cent of cases and with operable tumors of the outer quadrants in only about 20 per cent.

That the significance of location may have been overstressed is indicated by actual survival data, which show that the reported location of the primary tumor does *not* influence prognosis greatly. This fact is commonly overlooked by students of the breast cancer problem.

TABLE III: SITE OF PRIMARY TUMOR AND RELATIVE FIVE-YEAR ARREST RATES BY RADICAL MASTECTOMY (STAGES I AND II)

	Inner Quadrants	Outer Quadrants
Nohrman (1949)	48%	52%
Haagensen (1951)	49%	52%
Shimkin *et al.* (1952)	62%	63%
Pierce *et al.* (1956)	59%	63%

Clinical Duration: The relationship of *tumor duration* to spread is notoriously variable. Many patients understate the length of time the tumor has been present; many do not notice it until it is large. The frequency of axillary lymph node involvement in operable cases with a history of a lump in the breast of less than one month duration was found to be 50 per cent; this increased to 68 per cent for those with breast tumors of more than six months known duration (Haagensen).

McWhirter (53) has applied Collins' (16) observations to the *theoretical* growth rate or duration of breast tumors. Since the average diameter of a tumor cell is about 10μ, some 20 successive divisions or

doublings are required to produce a mass 1 mm. in diameter, 30 doublings a mass 1 cm. in diameter, 40 doublings a tumor 10 cm. in diameter, and 42 doublings a tumor equal to the size of a 7-pound infant. It is not supposed that all tumors grow at a constant rate, nor that factors such as necrosis can be ignored but, in considering the potential duration of a tumor, the calculations serve a purpose.

If an anaplastic cancer doubles its volume every month, a 1-cm. tumor of this type will have been present and growing for thirty months; the patient may recognize it only at that time: her history is of a "few days," but the true duration is thirty months. If a well differentiated tumor doubles every six months, the preclinical period will have been fifteen years, assuming its detection at 1-cm. size. In other words, the preclinical period is undoubtedly much longer than we have hitherto believed.

Macdonald (48), Gatch (29), and others (18) are now convinced that breast cancers fall into 3 main groups:

(*a*) Those that are highly malignant *de novo;* they have metastasized early in their development, long before the first clinical evidence of the primary tumor.

(*b*) Those that are of low metastasizing potential; they may remain localized for years.

(*c*) Those of intermediate growth potential.

Macdonald bases his conclusions on data obtained from the histologic examination of tumors and the relationship of nodal metastases to the size and curability of the primary lesion. "The sum of this evidence constitutes inexorable proof of a host-neoplasm relationship by which a balance of power is established between the invaded and the invader. The biologic factors involved in this struggle for survival are unknown, but the evidence indicates that the outcome is decided in the preclinical phase of the disease, and probably during its earliest inception. . . . From this it is apparent that biologic factors, more than the time of treatment, the size of the neoplasm, or even the type of treatment, profoundly influence prognosis. There is a minor fraction of patients in whom there is a direct, sequential correlation between time and local spread, and eventual distant metastasis." Macdonald estimates the proportion of cases in each of these biologic groups as follows:

Rapidly-growing or early disseminated type	55 per cent
Moderately rapidly growing, temporarily localized type	25 per cent
Slow-growing, localized type	20 per cent

For this reason, it is Macdonald's opinion that the absolute long-term cure rate for breast cancer cannot exceed 45 per cent.

Crile (18) also speculates on the probable existence of at least three separate types of breast cancer. The first is nonmetastasizing breast cancer, which behaves much like basal-cell skin cancer and may be cured by simple removal. The second is breast cancer with predilection for local lymph node spread but not for vascular dissemination; this may be curable by suitable excision or regional radiotherapy. The third is cancer with predilection for early and wide dissemination; the local manifestations of the primary may be controllable, but the disease is never curable, no matter how radical the surgical or other therapy. "Since operations may disseminate previously localized cancer through the blood stream, through the lymphatics, and by implantation, the pros and cons of operations for cancer must be weighed carefully before operations designed solely to prevent the spread of cancer are advised. The greatest challenge in the surgical field of cancer is to recognize and operate promptly on those patients whose cancers are adapted to surgical cure and to avoid operating on those in whom intervention does nothing but harm."

This philosophy is naturally disturbing, as is so often unvarnished realism. It has been called a doctrine of fatalism by some (74) and been accepted by others

reluctantly, with the observation that effectiveness of treatment must now be measured in terms of infrequency of local recurrence rather than in terms of cure. This is understandable. At first glance, it is as though one claimed that an operation as venerated as classical radical mastectomy is doomed to failure in 55 per cent of cases. In fact, it does not say this, since many of this 55 per cent would be in the group which experienced surgeons would have regarded as inoperable in the first place—because of signs of incurability. If applied to the cases in which it *is* indicated—admittedly not in excess of 50 per cent of all patients—it can be said that operation is "curative," in terms of five-year symptom-free survival, in most instances.

The prevailing difficulty is that we do not yet have a reliable method of determining in which group the truly operable patients may lie, and therefore must still proceed with prompt, adequate treatment in all clinically localized cases. If one could define the degree of malignancy at the time of diagnosis, treatment could be planned on a more logical and effective basis.

STAGING

The clinical staging of carcinoma is a crude but useful preliminary step in estimating prognosis, planning treatment, and comparing results. Clinical Stage I patients are often benefited by prompt vigorous treatment; Stage IV patients are potentially harmed by such, and should have palliative therapy. The prognosis in the two groups is correspondingly disparate.

Staging requires careful clinical and radiological examination of the patient, followed by histologic identification of the tumor. The former has been fully described elsewhere (33). X-ray examination usually consists of a "chest and bone survey." Since only about 9 per cent of clinically benign or questionable breast "lumps" prove to be carcinoma (33, 45), practical considerations suggest a reasonable minimal examination as follows: postero-anterior and lateral chest roentgenograms; anteroposterior and lateral roentgenograms of the skull, lumbosacral spine, and pelvis. In patients with signs or symptoms suggesting bone involvement elsewhere, suitable roentgenograms of that area or areas should be made. Stereoscopic projections with excellent detail are a *sine qua non*.

A widely used classification is that of Portmann (60): Stage I represents cases with cancer apparently localized to the breast, without involvement of the skin or lymph nodes, or attachment to deeper structures. Stage II includes similar cases, but with low axillary lymph node involvement. Stage III includes cases with skin involvement, satellite nodules, fixation, or extensive axillary node involvement. Stage IV consists of cases with evidence of distant metastases.[3]

This classification is made primarily on clinical grounds (subject to microscopic examination of the primary lesion). If it is modified by the microscopic *nodal* findings at exploration or operation, this fact should be indicated. Like clinical and radiographic examination, microscopic study has limitations, albeit to a much lesser degree. Time simply does not permit routine study of multiple sections of all nodes in a given specimen. When it does, as in the special investigations of Saphir and Amromin (66), and Schenken *et al.* (67), it is found that about 30 per cent of nodes initially called negative do contain tumor. The latter investigators concluded that at least 80 per cent of patients with breast cancers currently deemed operable already have axillary node metastases.

Williams *et al.* (76) have shown that staging based on expert clinical grounds (and not awaiting the histologic findings in the axillary nodes) is a rewarding procedure. In their series of over 1,000 cases the five-year survival rates in the various groups

[3] Space does not permit consideration of other excellent classifications, such as those of Smithers, Paterson, and Haagensen. There is a tentative International Classification (Denoix) which is too elaborate for current clinical use.

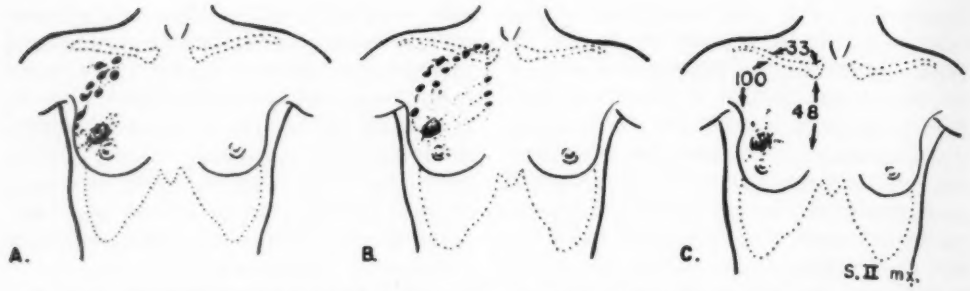


Fig. 5. A. Standard concept of a clinical Stage II case, on which the classical Halsted radical operation is based. Theoretically, the axillary nodes alone are involved, but such a situation prevails in only 10 to 14 per cent of *all* primary untreated breast cancer patients.

B. Actual lymph node status in a majority of Stage II cases. The standard radical mastectomy will not cure such patients.

C. Approximate percentage of metastatic nodes in cases verified microscopically as being Stage II. About 48 per cent of such patients have positive internal mammary nodes, and 33 per cent supraclavicular nodes. They are therefore incurable by standard radical mastectomy (for which operation the overall ten-year clinical cure rate is about 25 per cent).

fitted the clinical better than the microscopic staging!

Haagensen reports that some 25 per cent of patients seen at Columbia Presbyterian Medical Center are now judged unsuitable for radical mastectomy on clinical grounds alone, and that an additional 25 per cent prove to be unsuitable because cancer is found in the regional nodes (axillary or intercostal) on preliminary biopsy.

We have recently reported (26) a review of staging and end-results in 200 consecutive patients with primary breast cancer, of whom 96 per cent were traced for over five years or until death. One-half of the group was seen at a county hospital, in which patients with advanced disease preponderated, and one-half at a private hospital where only 3 per cent of the patients were classified as advanced. When the patients were considered according to the stage of disease, the five-year survival rates in the two hospitals were found to be essentially the same: 70 and 65 per cent respectively in Stage I patients, and 40 and 42 per cent in the Stage II. The staging, primarily on a clinical basis, proved a useful prognostic clue.

TREATMENT PROGRAM

The most effective treatment for cancer of the breast depends on the apparent extent and type of the tumor, the clinical status of the host, and the facilities available. Halsted (34) showed that when the tumor is of favorable biologic type and localized (Stage I or "axilla-only" Stage II), the operation bearing his name would provide a significant number of five-year clinical cures. For other types and stages, however, the operation proved disappointing and he was led to observe that its overall efficiency is to be "measured truer in terms of local recurrence than of ultimate cure."

One generation later, Coutard (17) showed that, by fractionation and protraction of irradiation, many carcinomas previously regarded as incurable could be cured by roentgen therapy. His major work was in the region of the head and neck, but his findings and technic were soon applied to tumors of other body sites. It was confirmed that irradiation could destroy or devitalize cancer cells in a proportion of those cases.

Again, after the lapse of almost another twenty-five years, McWhirter (50) showed that postoperative protracted roentgen therapy could control or cure mammary carcinoma in a certain number of women with Stage II or Stage III disease. Five-year survivals were obtained in over 200 women *with clinically involved axillary or supraclavicular nodes*—often gross, with

hard, fixed masses which disappeared under treatment and did not recur (52). Since microscopic Stage I and Stage II lesions are indistinguishable on clinical grounds alone, he felt he should apply radical postoperative radiotherapy to all cases in an effort to cure.

When the tumor is spread beyond the above sites (*i.e.*, is clinical Stage III or Stage IV), complete removal is seldom

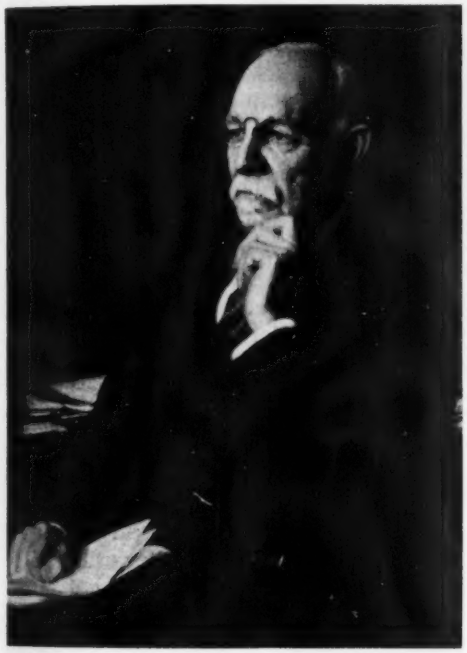


Fig. 6. William S. Halsted, 1852–1922. (Courtesy E. F. Lewison)

feasible, and radical attempts at such were found to augment the spread of disease, increase the patient's discomfort, or shorten the span of life. Most of these were therefore assigned to radiotherapy.

We have presented in a previous publication (28) the evidence that the proportion of patients in Stage II with metastatic nodes localized to the removable portion of the axilla is only between 10 and 14 per cent of all females with breast cancer seen under ordinary conditions of clinical practice. This is the one and only group in which the classical radical mastectomy

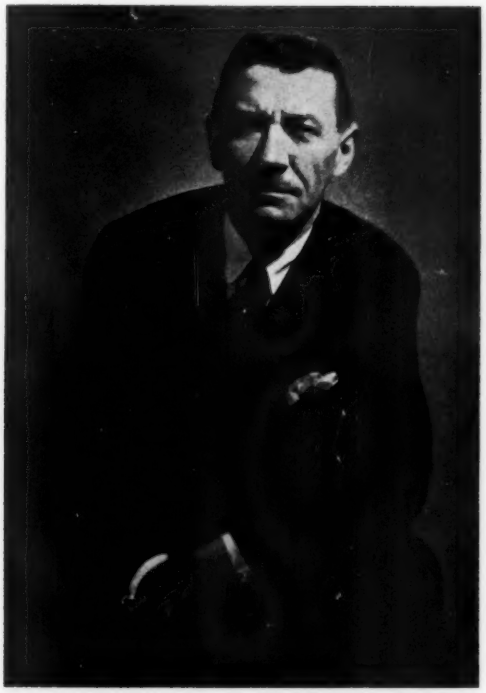


Fig. 7. Henri Coutard, 1876–1950.

can be regarded as essential for surgical cure. In Stage I it is unnecessary; in Stage III it cannot succeed. There is now clinical evidence that radiotherapy is as effective as surgery in most patients in this "select" or "axillary-node-only" Stage II group, and that it *is* superior to attempted radical operation in the remainder (53, 72).

It is necessary to establish the fact that a given breast lump *is* carcinoma prior to vigorous treatment of any type. For this reason, in most clinically localized cases, mammary exploration is required. If the lump is microscopically cancer, simple excision of the breast is the swiftest method of ablation.[4] If the patient is in clinical Stages I to III, she should

[4] *Simple mastectomy* means operative removal of the breast *via* a limited skin incision, usually transverse. When the tumor is firmly fixed to the pectoral fascia, McWhirter advises removal of such along with the pectoral muscle. Otherwise, the fascia and muscle are not disturbed. Superficial, mobile nodes are also removed, but axillary dissection is not advised.

Fig. 8. Robert McWhirter, 1905–.

usually be given the benefit of radical postoperative irradiation.

The advantages of this program include the following:

1. The mortality rate is lower than that of radical mastectomy which, in general, is still about 1 per cent (33).

2. There is less chance of dissemination of cancer cells, by avoidance of prolonged dissection in tissues infiltrated with cancer, as is necessary in block removal of the axillary contents (54).

3. There is less disabling postoperative arm edema, which occurs in from 5 to 23 per cent of patients after radical mastectomy and in a smaller percentage after simple mastectomy (19a).

4. There is less chest wall deformity.

5. There is a better absolute five-year survival rate in an unselected group of patients (51).

The disadvantages include:

1. Morbidity from radiation reaction, which occurs in about 5 per cent of the patients and includes delayed skin healing, severe late telangiectasis, etc. This contraindicates irradiation in the very elderly or debilitated, and to a certain extent in persons under fifty who are fair complexioned.

2. Failure to control radioresistant but potentially removable axillary metastases. These are estimated to occur in about one-third of the patients with node disease localized to the axilla alone, *i.e., not more than 5 per 100 females with primary breast cancer* (52).

3. Inadequate dosage in very thick or obese patients.

4. Radiation injuries as a results of technical errors such as x-ray beam overlap (avoidable by constant attention to detail).

5. Potential aggravation of underlying vascular or pulmonary disorder, *e.g.*, severe peripheral arterial disease, active pulmonary tuberculosis, etc.

The disadvantages listed under points 3 and 5 require the recommendation of the alternative method (radical mastectomy[5]) when such conditions prevail. When, for those reasons (girth, vascular, or pulmonary disease), radical operation has been performed, we believe that postoperative radiotherapy is indicated in all but "small" (less than about 1 cm.) Stage I lesions of apparently favorable biologic type. This therapy should be directed to the axillary and supraclavicular node areas and, with juxtasternal lesions, to the internal mammary chain, up to a tissue dose of about 4,000 rads in three to four weeks time.

Concerning Stage III lesions, there is evidence that most cases should be cared for by radiotherapy alone (33, 76); however, selected patients in this stage will apparently benefit from the program recommended for the two earlier stages. That

[5] Radical mastectomy of the Halsted type requires from five to six hours, according to Haagensen. The standard radical type of mastectomy, commonly described as Halstedian, has actually evolved from the "less meticulous but quicker" Willy Meyer procedure and, he believes, should be so designated.

radiotherapy is preferable to surgery when the supraclavicular nodes are involved is stressed by most surgeons (20, 33, 40). Some patients in Stage IV may best be cared for by hormonal alteration alone.

TECHNIC

On about the tenth postoperative day, 4 fields are marked on the skin on the involved side, with the arm abducted and the head rotated to the opposite side. The opposing "shoulder" fields measure about 10 × 25-cm. and cross-fire the axillary and supraclavicular areas. The anterior field extends from the midline to the junction of the pectoralis major with the humerus. Its inferior border lies at the upper edge of the second costal cartilage. The posterior field has its medial end placed a little higher or more cephalad than the anterior field, in order to include the posterior cervical lymph node chain; a pillow is placed under the shoulder and arm to level the skin surface. The anterior beam may be angled slightly mesiad, according to the thickness of the shoulder. The posterior beam is not angled.

The tangential chest wall fields are 10 × 15-cm. each, and oppose one another. The edge of the mesial field is placed about 2 cm. beyond the midline; the edge of the lateral field is placed just beyond the border of the pectoralis major, both edges parallel to the long axis of the body. When possible, the distance between the "faces" of the tangential fields is about 16 cm. If it has to be more, the mesial field is angled about 12° toward the chest

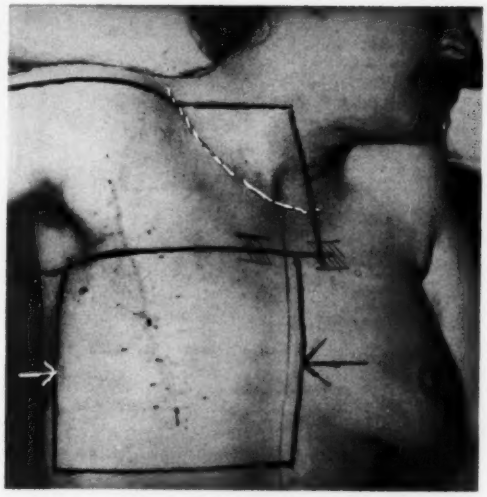


Fig. 9. Approximate position of anterior shoulder field and tangential chest wall fields. The arm is abducted to a right angle and the head is rotated to the opposite side. To maintain as level a surface as possible, only one pillow is used. The boundaries of the anterior shoulder field are the midline, the upper margin of the second costal cartilage, the junction of the pectoralis major with the humerus, and the superior border, a line about 10 cm. cephalad of the inferior. Details of this and of the tangential fields are given in the text.

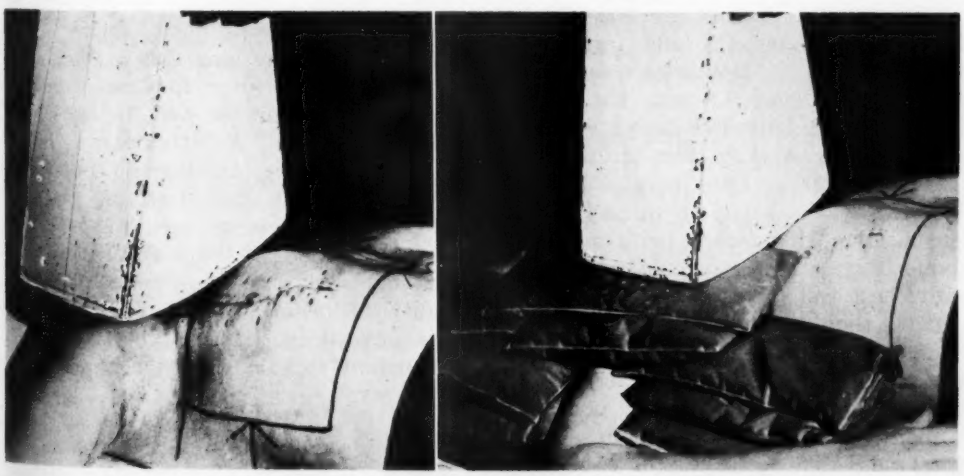


Fig. 10. Actual set-up of anterior shoulder field, without and with bolus bags.

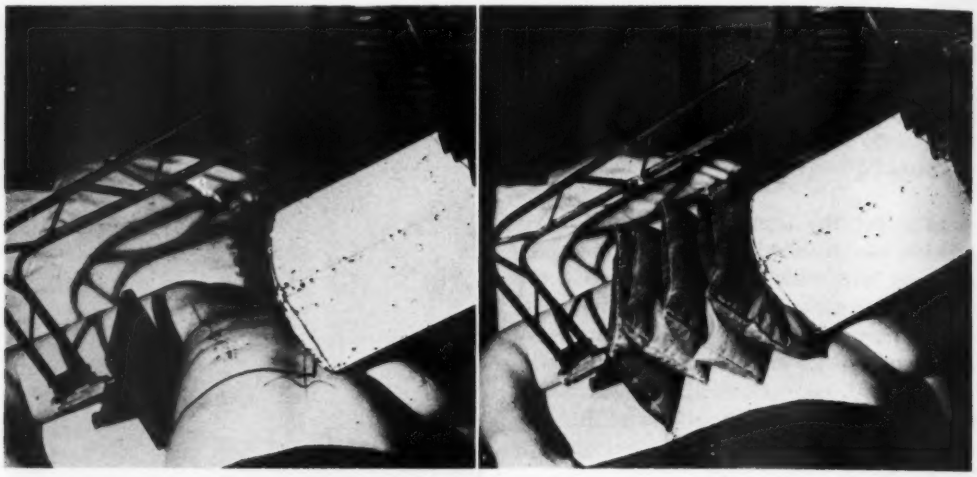


Fig. 11. Actual set-up of mesial tangential chest wall field, without and with bolus bags. (Figs. 9 to 11 are photographs from the Royal Infirmary, Edinburgh, courtesy of Professor McWhirter.)

wall. The attempt is made to include the homolateral internal mammary node region in the chest wall cross-fire. It is my impression that bolus material is not essential in many cases with fairly "flat" anterior chest walls. This impression is strengthened by the observations of Clarkson (15), Clarke (14), and Lochman (46). Bolus certainly increases the uniformity of skin dose in patients with *intact* breasts (who are to be treated by radiotherapy alone, on account of systemic or advanced disease).

The technical factors are 200–250 kv, h.v.l. 1 to 2 mm. Cu, and target skin distance 50 cm. (McWhirter recommends a h.v.l. of at least 3.8 mm. Cu.) Each field is treated daily, five days a week, for three to four weeks. The air dose per field is from 200 to 150 r daily. The total dose is about 3,000 r/air to each of the four fields. This means, with a patient about 16 cm. thick at shoulder level, and with chest wall fields of similar spacing, that the shoulder fields receive a skin dose (including exit dose) of about 4,750 rads, and the chest wall fields, of about 4,350 rads. The midshoulder lymph node dose is about 4,000 rads, and the midchest wall 3,700 rads. Theoretically, the dose should be increased when the treatment time is extended to four weeks, but practically it is difficult to do so.

TABLE IV: SUMMARY OF PLANNED COURSE (20 TREATMENT DAYS)

Field	Incident Dose		Transmitted Dose	Total Skin Dose	Total Central Tissue Dose
	Air	Skin			
Shoulder	3,000	4,000	750	4,750	4,000
Chest wall	3,000	3,750	600	4,350	3,600

It is to be noted that Professor McWhirter's technic has varied over the years. When I visited his department in 1950, the chest-wall fields sloped at a slight angle to the long axis of the body (Fig. 17). The filter for the shoulder fields was 1.5 mm. Sn, and for the chest wall fields 0.4 Sn. An attempt was made to complete the treatment course in fifteen treatment days, and the planned minimum tumor dose was 3,750 r, the maximum 4,500 r. Dr. McWhirter now uses four weeks and a somewhat harder quality of beam, without compensatory increase in dose. He has kindly sent me his current technic which is summarized as follows:

Factors: 300 kv, FSD 50 cm., h.v.l. 3.8 mm. Cu, bolus.

Shoulder fields 10 × 25-cm., anterior and posterior.

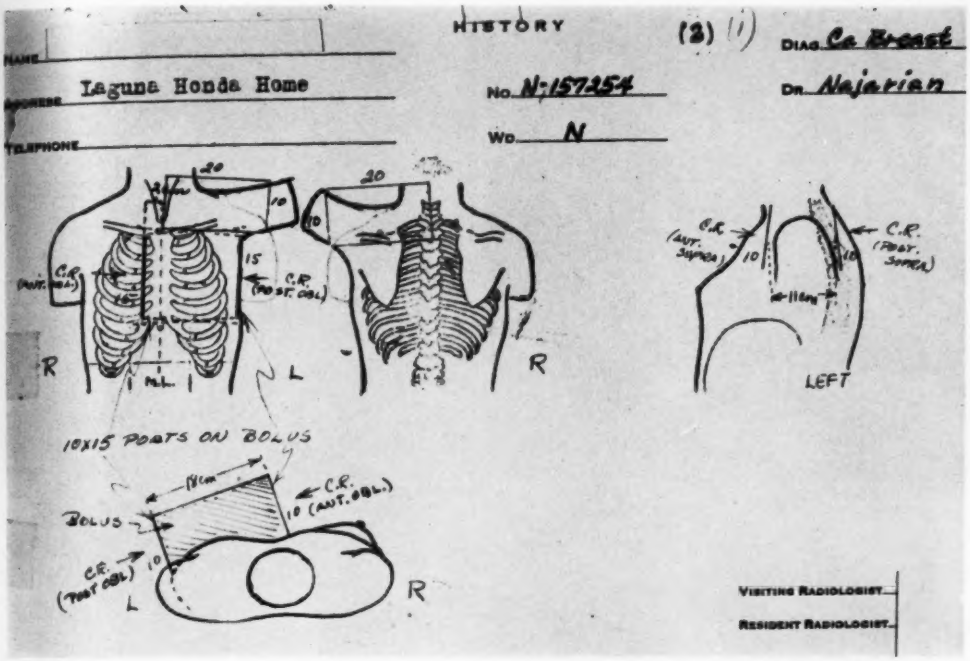


Fig. 12. Diagrams from a patient's record, to show incorrect location of "shoulder" fields. The inferior border of these should be the upper edge of the second costal cartilage, anteriorly, and the lower axilla posteriorly. Bolus is not routinely used.

Each field treated daily, five days a week, for four weeks.
The anterior beam is angled mesiad: for thickness 13–15 cm., angle 11°; for 16–21 cm., 16°.
Daily dose per field 152 to 182 rads, according to thickness.
Total dose, per field, including transmitted, 4,250 rads.
Estimated central dose 4,350–3,560 rads.
For shoulders over 21 cm. thick, radical mastectomy preferred.
Chest wall fields 10 × 15 cm., tangential.
Each field treated daily, five days a week, for four weeks.
The daily dose per field increases with the degree of separation necessary:
15–16 cm. spacing, 183 rads,
16–18 cm. spacing, 192 rads,
18–20 cm. spacing, 200 rads.
The incident skin dose varies from 3,660 to 4,010 rads.
Estimated minimum tissue dose 3,370–3,880 rads; maximum 4,250 rads.

MORBIDITY

Skin: There is a transitory moist epithelitis in about half the patients; this is occasionally delayed for ten days, and rarely very severe. Necrosis does not occur with proper technic and avoidance of heavy irradiation in the presence of wound infection. Radiotherapy must be deferred until after infection is cleared up. Late telangiectasis and atrophy will develop in a certain percentage of patients, but usually not to an unsightly degree (Figs. 13–15).

Pleura and Lung: There is seldom any severe degree of "pneumonitis" or fibrosis. A slender anterior "strip" or an apical segmental area of pulmonic reaction is seen; the degree of change after five years has been minimal in my experience.

Bone and Cartilage: A certain number of cases of decalcification of small zones on the anterior aspects of the upper ribs are seen. This radiation "osteitis" is usually silent, even though radiographic findings resemble fractures. Chondritis or chondromalacia is not clinically apparent with the dose program recommended.

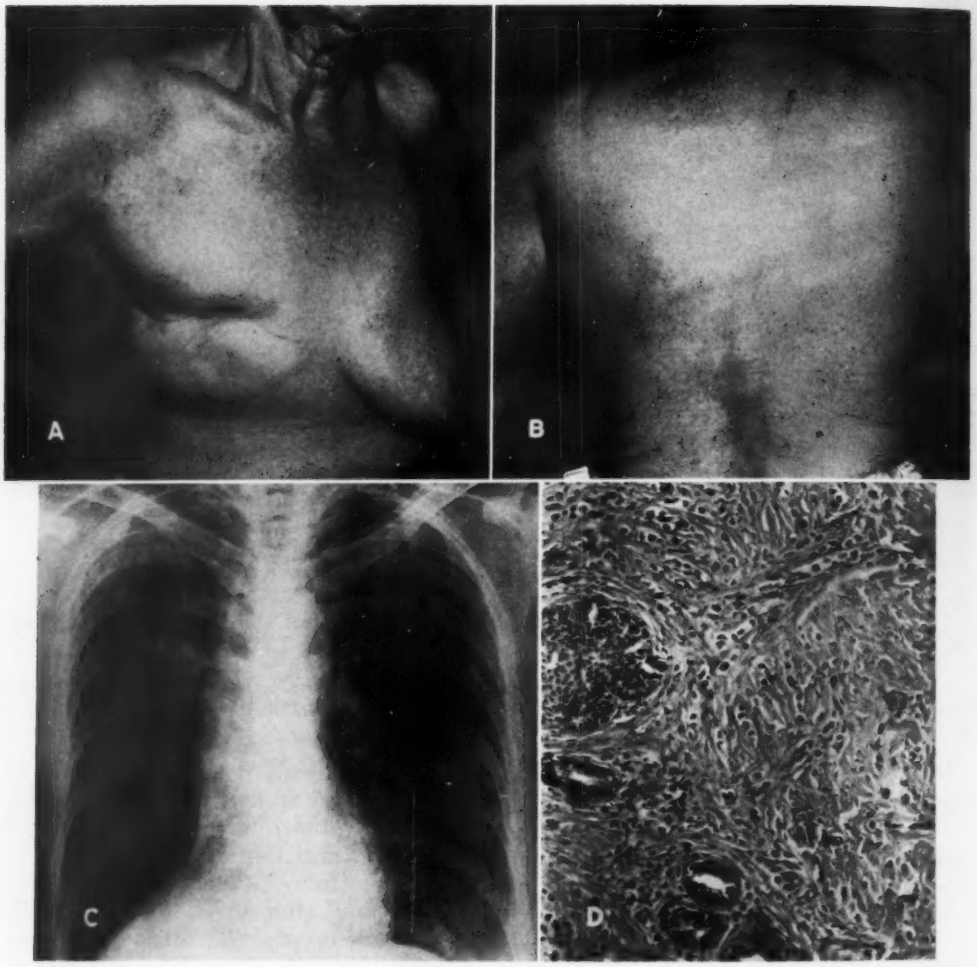


Fig. 13. A and B. Appearance five years after radiotherapy. Mrs. N. K., aged 57, with Stage I carcinoma of the right breast treated by simple mastectomy and radical postoperative radiotherapy. Brisk erythema at end of treatment; minimal residual telangiectasis on anterior and posterior chest wall. C. Chest roentgenogram 5 years after treatment. Minimal pleuropulmonary reaction in right upper lobe. D. Histologic appearance of primary tumor.

Trachea and Esophagus: Transitory hoarseness, cough and dysphagia may develop near the termination of treatment and prove temporarily distressing. The larynx should, of course, be protected from the primary beam.

RESULTS

Personal: We have treated a total of 62 patients with primary carcinoma of the breast by vigorous radiotherapy following simple mastectomy. Some 25 of this group were treated as part of an investigation of the McWhirter program; the remainder had simple mastectomy for various reasons such as poor physical status, age, anesthesia complication, choice of operating surgeon, etc. Somewhat over one-third of the entire group was treated by strict McWhirter technic, the remainder by modified McWhirter technic, that is, vigorous roentgen therapy to the

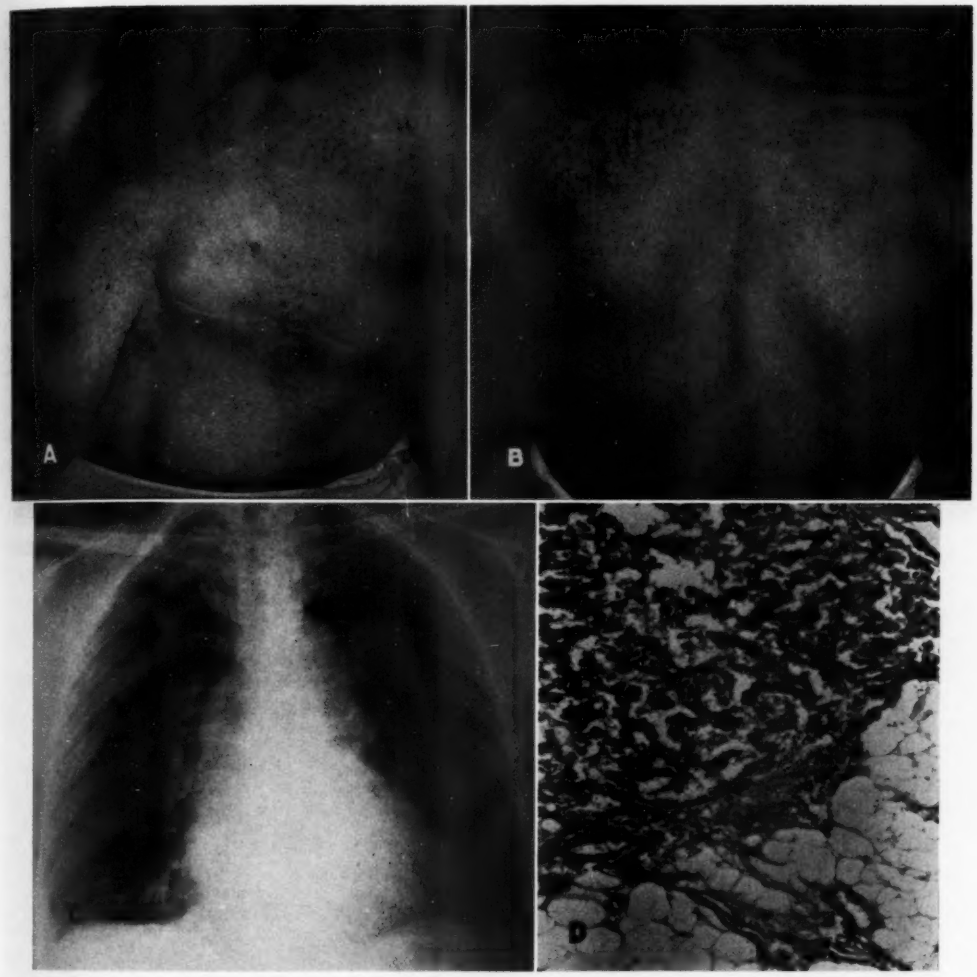


Fig. 14. A and B. Appearance five years after radiotherapy. Mrs. S. R., aged 66, with Stage I carcinoma of left breast, treated by simple mastectomy and radical postoperative radiotherapy. No marked erythema at end of treatment. Moderate degree of residual telangiectasis and skin atrophy anteriorly and posteriorly. C. Chest x-ray five years after treatment. No pulmonary changes; silent radio-osteitis of left second rib anteriorly. D. Histologic appearance of primary tumor.

axillary, supraclavicular, and upper mediastinal areas but with lower dosage to the anterior chest wall.

Of the 62 patients, 37 were treated over five years ago and are suitable for preliminary survival review. Nineteen of the 37, or 51 per cent, survived for five years. Two of the survivors were found to have silent bone metastases in the fifth year. Three died of causes other than cancer, but are included as failures since they did not survive the "trial" period.

Of the 37 patients, 11 were classified as Stage I (and 9 of these survived); 17 were classified as Stage II (of whom 10 survived); 9 were classified as Stage III or IV (in this group none survived).

Considering the Stage I and Stage II cases as the potentially operable group, it is noted that 19 of 28 patients, or 67 per cent, survived for five years. This is within the range reported by other observers for small selected series (see below). Of this group, only 1 developed clinical

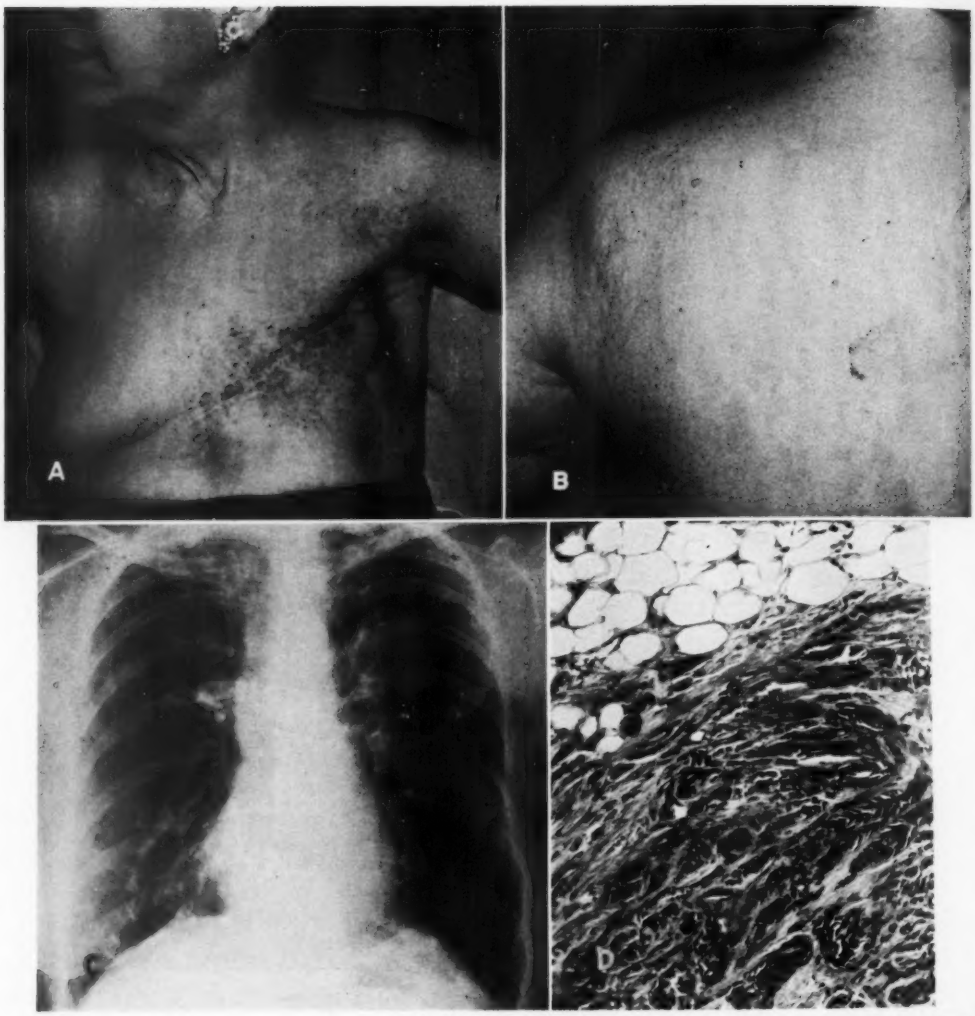


Fig. 15. A and B. Appearance five years after radiotherapy. Mrs. M. L. D., aged 57, with Stage II carcinoma of breast, treated by simple mastectomy and radical postoperative radiotherapy. Fairly marked residual telangiectasis and atrophy on anterior and posterior chest wall. C. Chest roentgenogram five years after treatment shows minimal pulmonary changes. D. Histologic appearance of primary tumor.

evidence of chest wall "recurrence." This was near the inferior angle of the scapula and outside the field of irradiation; it would, I believe, also have been outside the field of radical operation.

The degree of initial skin reaction ranged from moderate in most cases, to severe in a few. The late skin changes corresponded in general with the severity of the earlier ones. As in other conditions, the level of reaction varied in different individuals, despite similar administered dosage. Pulmonic reaction was not a problem, but it is to be noted that the tangential fields did

TABLE V: FIVE-YEAR SURVIVALS, SIMPLE MASTECTOMY PLUS RADIOTHERAPY

	Stage			Total
	I	II	III and IV	
Number of cases	11	17	9	37
Number of survivors	9	10	0	19 (51%)

not always include as much lung tissue as the modern McWhirter procedure calls for. The illustrations show the status of the treated skin fields and lung tissue in 3 of the fully treated patients five years after radiotherapy: 2 are classified as mild skin changes and 1 as severe; all are classified as mild in respect to pulmonic or osseous changes.

From the Literature: The results obtained by simple mastectomy and postoperative radiotherapy have been published from several different clinics and countries (25, 51, 56, 57). There has been an increase in the proportion of patients accorded this form of treatment in recent years. For example, the Queensland Radium Institute (63), in its Annual Report for 1955–56, reported a 700 per cent increase in the frequency of simple mastectomy plus radiotherapy and a 50 per cent decrease in the radical operation, during the last decade (Table VI).

TABLE VI: METHOD OF TREATMENT (QUEENSLAND RADIUM INSTITUTE)

Years	Simple Mastectomy and Radiotherapy	Radical Mastectomy and Radiotherapy	Other Methods (Including X-ray Only)
1945–1950	84	569	165
1951–1955	556	280	135

Incidentally, the *relative* five-year survival rate of the simple procedure in all stages combined was 50 per cent and of the radical operation 43 per cent in this particular clinic.

Williams *et al.* (76) report a five-year relative survival rate of 62 per cent in 165 patients treated by simple operation and postoperative radiotherapy.

McWhirter (52) reports the following experience with 2,507 patients seen between 1941 and 1949 in Edinburgh (the regional population of which is about one million persons):

Cases	Type of Treatment (University of Edinburgh, 1941–49)
159	Radical mastectomy
1,667	Simple mastectomy and adequate radiotherapy
171	Simple mastectomy and inadequate radiotherapy
58	Simple mastectomy alone
80	Palliative radiotherapy
28	No treatment
344	Miscellaneous treatment (all Stage IV)

In other words, about 73 per cent of the patients were given definitive treatment in an attempt to cure, and about 27 per cent palliative or no treatment. "Patients with acute cancers, with numerous skin nodules, with the primary tumor fixed to the ribs or with fixed axillary nodes in continuity with the primary tumor, could not have a simple mastectomy performed for this would have meant cutting through gross disease. Those patients were treated entirely by palliative radiotherapy. Some elderly patients had only a simple mastectomy performed and no radiotherapy was given. The most advanced cases had no treatment at all."

The patients were divided into 3 categories: operable (*i.e.*, those in Stage I or II and some who would fall into Portmann's Stage III), locally advanced (mostly Stage III), distant metastasis (Stage IV). All but 1 patient is reported traced, and the following are the absolute five- and ten-year survival rates:

TABLE VII: MCWHIRTER'S RESULTS

Category	Cases	Five-Year	Ten-Year
Operable	1,469	58%	39%
Locally advanced	694	30%	16%
Distant metastasis	344	4%	1%

The absolute overall survival rate was 42 per cent. The comparable result of the radical procedure in the same community prior to the inception of this program was 31 per cent.

McWhirter analyzed his material from the clinical and radiographic points of view, and estimated his percentage of cases in the various stages approximately as follows:

Stage I—22%
II—34%
III—29%
IV—15%

In the light of the axillary findings in the cases submitted to radical operation, both at Edinburgh and elsewhere, he calculated that his microscopic Stage II cases, *i.e.*, cases with axillary and other regional node involvement, would have amounted potentially to about 34 per cent. If these cases had been subjected to internal mammary and supraclavicular node exploration, they would presumably (based on the work of Handley and others) have shown the following distribution:

Axillary nodes alone involved	14%
Axillary nodes and internal mammary or supraclavicular nodes	20%

The radical operation, strictly speaking, could have been logically applicable and effective in most of his Stage I cases (22 per cent) and in the localized Stage II cases (14 per cent), giving a yield of perhaps 33 per cent five-year survivors. The simple-operation-plus-radiotherapy program was applicable in a larger proportion—over 60 per cent—and proved effective in over two-thirds of the cases.

TABLE VIII: RESULTS OF SIMPLE MASTECTOMY AND POSTOPERATIVE RADIOTHERAPY, STAGES I AND II

Cases	Five-Year Survival	Author
1,469	58%	McWhirter (52)
808	60%	Deaton (collected) (20)
165	62%	Williams *et al.* (76)
139	65%	Garland (collected) (28)
28	67%	Garland (personal)

ADVANCED DISEASE

For most patients with Stage IV breast cancer, palliative radiotherapy is the primary treatment of choice. It offers the best chance of temporary control, with the fewest side-effects or complications.

The following dose ranges are regarded as often desirable: for primary tumor and regional nodes 3,000 to 4,000 rads in three to five weeks; for pulmonary, pleural, or cerebral metastases 2,500 rads in three weeks; for osseous lesions 1,000 rads in one to two weeks; for skin lesions 2,000 to 3,500 rads in two days to two weeks, according to size, number, extent, etc.

Alterations of the hormonal milieu by subtractive or additive therapy may help some patients. In premenopausal years, castration results in subjective remission in about 55 per cent of symptomatic patients, and in objective improvement in about 20 per cent.

There are no significant differences in clinical results between surgical and roentgen castration; the former has the advantage of speed, the latter of minimal trauma and economy. The dose must be actually delivered to the gonads and graded to the physiologic status thereof. That is, radiation fields must be large enough surely to encompass the ovaries, and the dose must be increased with youth. A simple plan is to use an ovarian dose of about 1,000 rads in six days at age fifty, of about 1,500 rads in ten days at age forty, and 2,500 rads in twenty days at age thirty. Castration is recommended in most premenopausal women with apparently actively growing tumors, and in patients with Stage III or Stage IV disease, especially osseous.

For those who are past the menopause, or fail to respond to castration or radiotherapy, additive hormone therapy should usually be tried first. Patients less than five years past the menopause should be started on androgenic therapy, those more than five years postmenopausal, on estrogenic therapy (27). As with castration, it is difficult to predict which patient will respond. When remission is going to occur, it will usually be apparent in the first three months of treatment. If it does not occur within that interval, and there is no reactivation or progression of disease, medication should be continued for another three months. The contraindications to additive hormone therapy, and its complications, are numerous (27) and will not be dealt with here.

To aid in reducing complications, Jessiman and Moore (40) recommend certain endocrine assays prior to therapy. In menopausal or castrated women, low urine assays for FSH (follicle-stimulating hormone) usually signify persistent estrogen

activity, and therefore may indicate adrenal or hypophyseal ablation. Urinary mammotrophin studies may aid in selecting cases for the latter procedure.

Other forms of subtractive hormone therapy are adrenalectomy and hypophysectomy. The latter is apparently preferable and, when done by the transnasal approach, has a low mortality and morbidity. It is helpful in about 20 per cent of patients—sometimes brilliantly. We recommend it in patients under seventy with progressive generalized disease no longer responsive to irradiation or hormone therapy. In our limited experience, hypophysectomy is preferable to adrenalectomy. The place of cortisone therapy as a substitute for the latter is still unsettled.

Finally, chemotherapy, notably with triethylenethiophosphoramide, has been used in a small number of advanced metastatic cases which had become nonresponsive to hormone therapy (55). Beneficial results were obtained in some, but it is not clear that *adequate irradiation* had been tried first. In the presence of bone metastases, the latter gives pain relief more quickly and more surely than any other form of treatment. Chemotherapy with intrapleural nitrogen mustard will help some patients with neoplastic effusion.

DISCUSSION

Survival without treatment is unquestionably less than survival with adequate treatment—despite Jones (41), Lees (43) and Park (58) to the contrary. We have studied Daland's and Greenwood's material and agree with Nohrman's conclusions, published in the *Acta Radiologica*, supplementum 77, that about 13 per cent of untreated patients with breast cancer survive five years, and about 5 per cent survive ten years, calculated from the time of potential treatment, *i.e.*, some six to twelve months after the first symptom was noticed by the patient (28).

Survival with treatment depends on the stage and type of disease present, the age of the patient and, to a lesser extent, the type of treatment itself. The most satisfactory way of assessing the modest results of treatment is with twenty-year, age-grouped survival curves (Small and Dutton, 71). It is well known that many cases of breast cancer recur after being apparently arrested for five or ten years, and a few even after twenty or twenty-five years. However, it is not always possible to express results in such desirable long-term figures. Reasonable comparison may be made with results obtained in other clinics by indicating the origin of the cases, the proportion in the various stages, and the five-year survival data.[6] Some of these five-year survivals will have persistent or "recurrent" cancer at the time of reporting; some will manifest "recurrent" cancer at variable times thereafter. But, given the associated data, the five-year survival figures do permit deductions as to the *trend* of "results" in any given clinic or hospital. For purposes of expressing results in percentages it would be desirable to have at least 100 cases in each of the stages, and that all cases be followed.

Most treatment results are based, naturally, on treated cases. This gives a clue to the benefits of the particular treatment applied, but not to the degree of control of the disease in question. They are *relative*, not *absolute* results. To measure the degree of disease control, all primary cases seen at the institution should be listed, and the results given on an *absolute* basis.

The best results of radical mastectomy are currently reported to show a figure of 67 per cent five-year survivals (33); this is a relative figure and means 67 per cent of the cases selected as being operable, not of the entire group of patients seen. It is understandable that active surgical clinics should, when possible, admit mostly operable cases on their wards. Therefore, "absolute" data published from such clinics require interpretation in the light of the fact that some Stage III and Stage IV cases are excluded.

[6] Schrek (68) and others recommend the 50 per cent survival time (or L.T. 50).

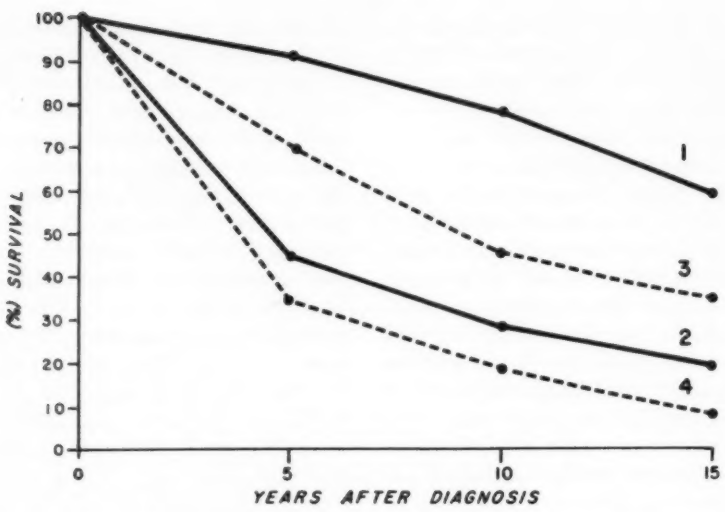


Fig. 16. Survival of female breast cancer patients (Curves 2 to 4) contrasted with average life expectancy (Curve 1). From *Cancer in Connecticut.*

1. Expected survival rate in females, aged 55 to 64, without cancer.
2. Survival rates in females with breast cancer diagnosed after 1935 (all ages).
3. Survival rates in females with "localized" breast cancer, ages 55 to 64.
4. Survival rates in females with "regional spread," aged 55 to 64.

There were no five-year survivals in patients with "remote disease," aged 55 to 64.

The closest to truly absolute data in treatment results of mammary cancer are believed to be those from Stockholm and Edinburgh. These are two cities with a significant degree of centralization of breast cancer patients in all stages, and with almost 100 per cent follow-up.

The general results of radical surgical treatment of carcinoma of the breast in the United States reveal a five-year *absolute survival* figure of about 35 per cent (33). The five-year *relative survival* rate for radical mastectomy is approximately 50 per cent; the five year *relative cure* rate 40 per cent (Haagensen). These three different figures all reflect one and the same number of patients and include a number of cases given augmented treatment in the form of radiotherapy, hormone therapy, or chemotherapy.

Atkins, in a notable lecture delivered before the Royal College of Surgeons of Edinburgh last year (7), reported an absolute five-year survival rate of 37 per cent with radical mastectomy with or without radiotherapy, hormone therapy, and other adjuncts. He states that his results are not as good as McWhirter's and makes certain other observations of note: (*a*) His end results indicated that spread of tumor occurs prior to operation in a higher proportion of cases than he hitherto supposed. (*b*) Many of his five-year survivals had the benefit of endocrine therapy, probably aiding a fair proportion in their survival. (*c*) Edema of the arm of significant or severe degree occurred in

TABLE IX: CANCER OF THE BREAST: COMPARATIVE RESULTS OF RADICAL MASTECTOMY AND SIMPLE MASTECTOMY PLUS RADIOTHERAPY

(Atkins, Guy's Hospital, 179 cases, 1957; McWhirter, Edinburgh, 2,507 cases, 1956)

Stage of Disease	Five-Year Absolute Survival Rate	
	Radical Operation	Simple Operation Plus X-ray
Operable (Stages I and II)	59%	58%
Locally advanced (III)	16%	30%
Distant metastases (IV)	5%	4%
TOTAL	37%	42%

NOTE: The Stage III group numbered 43 and 694 cases, respectively.

TABLE X: ABSOLUTE FIVE-YEAR SURVIVAL RATES IN BREAST CANCER

Author	Place	Year	Rate (per cent)
Nohrman	Stockholm	1949	40
Smithers	London	1952	35
Williams	London	1953	34
Bryant	Michigan	1954	40
McWhirter	Edinburgh	1955	42
Hickey	Iowa	1956	36

15 per cent of his material. (*d*) "*If we can get as good results without recourse to the mutilation of radical mastectomy, then we must discard this operation, whatever the theoretical considerations may dictate*" (italics ours).

It is to be noted that Atkins' survival rate in Stage III cases was only 16 per cent, while that of McWhirter was almost twice as good.

Table X summarizes what appear to me to be the most reliable available data on absolute results of the treatment of mammary cancer today.

The excellent results of Haagensen (33), Harrington (36) and the University of Chicago group (65) are intentionally not listed because it is believed that they represent *relative* data—the results of selected hospital populations—and are not strictly comparable with absolute data. Similar remarks apply to the recent report of the Saskatchewan cancer clinics, in which the excellent five-year survival rate of 48 per cent was obtained by radical mastectomy and radiotherapy in 629 patients (75). By selection of cases, surgical results can approach 80 per cent relative five-year survivals in Stage I patients, and 67 per cent for all operable patients; but such groups do not contain many advanced lesions. McWhirter's figures represent the results of treatment of virtually *all* breast cancer occurring in a community, which is the problem we must face in this and other diseases.

COMPARISON OF RELATIVE RESULTS

In *Surgical Clinics of North America*, Adair (4) published the following figures as representative five-year survival results of radical mastectomy in primary operable cases (presumably mostly Stages I and II):

Harrington	(Rochester)	51%
Lahey Clinic	(Boston)	52%
Rosenquist	(Stockholm)	54%
Adair	(New York)	54%

Comparison of these figures with those in Table X suggests that the results obtained with the simple operation plus radiotherapy are superior.

The number of surgeons advocating simple mastectomy as preferable to the radical operation for most cases of breast cancer is increasing. Deaton (20) reported collected data on 808 patients; Meyer and Smith (54) on 142 patients. Crile (18) advocates the procedure in selected patients, as do Jessiman and Francis Moore of Harvard (40), who would reserve radical mastectomy "entirely for Stage I and very early Stage II lesions. . . . In cases with frank axillary involvement, the McWhirter regimen or some similar approach offers a better survival rate and possibly a lower mortality than radical surgery."

Urban objects to the proposed program because radical mastectomy gives "better results in patients with relatively early disease." Proof of this is lacking. By relatively early disease he means disease localized to the breast or removable regional nodes: the former should be as curable by simple as by radical operation, the latter shows as good or better long-term control by radical radiotherapy as by surgery. The nodal classification is, of course, by microscopy in one instance and by palpation in the other. Routine microscopic examination is known to carry a false negative error of some 30 per cent; clinical palpability is generally acceptable for supraclavicular node involvement; *of course*, it would be preferable if we knew the precise extent of disease in every case, but the very procedures for ascertaining such (dissection, triple biopsy and the like) are fraught with hazard of dissemination, especially of anaplastic lesions. If *all cases* in each program are listed and followed, then the results may be com-

pared irrespective of nodal microscopy. Haagensen notes (in *Modern Medicine* for September 1957) that in New York State "93 per cent of women who come to physicians for breast carcinoma are operated on forthwith," despite the fact that at his institution only about 51 per cent are regarded logically or safely eligible for radical mastectomy. If the general approach were modified to include the procedures we recommend, there would be less needless radical surgery.

Finally, it should be noted that unfortunately both the radical surgical program and the McWhirter program fail to achieve long-time cure in a majority of cases. The Connecticut data confirm our observation that of those surviving five years, approximately one-third will die of breast cancer during the next five years, and one-half of cancer or other condition before another ten years have elapsed. The late mortality of breast cancer patients is in contrast to that of cervical cancer, and a sobering index of the relentless lethality of the disease.

TABLE XI: SURVIVALS OF FEMALE CANCER PATIENTS, AGED 45–54, WITH "LOCALIZED" TUMORS

	Breast	Cervix
A. Percentage surviving from diagnosis to five years	72	59
B. Percentage of those alive at five years who died during the next ten years	49	32

From *Cancer in Connecticut*, 1956, p. 58.

PATHOLOGIC VALIDATION OF EDINBURGH MATERIAL

A distinguished American pathologist, Dr. L. V. Ackerman of St. Louis, was invited to review the pathologic material at the University of Edinburgh (1). Records of 1,882 patients treated by McWhirter between 1941 and 1947 were placed at his disposal; he chose those of the 786 patients who had survived for five or more years and confirmed the diagnosis of cancer in over 98 per cent of the cases reviewed—a remarkable and unique episode in international cancer study. Ackerman stated certain objections to the program, which may be considered as follows:

1. It is complicated by ancillary procedures such as castration or hormone therapy in 220 cases. Well, similar series of breast cancer cases treated by radical surgery are also complicated by these very same factors (cf. Atkins). There is probably no such thing as a pure surgical or radiological series.

2. There is a "fairly high local tumor persistence rate." This is to be expected in any large series of patients who have been accorded treatment, irrespective of the stage of disease. Furthermore, similar tumor persistence or recurrence is reported in all unselected radically operated groups.

3. A morbidity rate from roentgen therapy of 2.5 per cent (47 of 1,882 cases) was noted. A little enquiry would have shown that most of these cases had been treated during the early World War II years, when the staff was depleted and treatments frequently interrupted by air raids. For some reason Ackerman failed to note that radical surgery also carries a morbidity rate (including arm edema, occasional arm disability, brachial neuritis, skin necrosis, etc.).

4. It was observed that many of the Edinburgh patients, though surviving five or more years, still had cancer. This observation is, alas, equally applicable to the radical operation, since one-third of radical mastectomy five-year survivals unfortunately succumb to breast cancer before the tenth year, and some continue to die of the disease in ensuing decades.

5. It was objected that histologic proof of tumor sterilization in lymph nodes was lacking. This is not surprising, since the nodes ordinarily removed for study at a late stage are precisely those which have failed to respond to treatment. The hard, fixed nodes of other cases which have disappeared under treatment would not ordinarily be biopsied. It is not claimed that radiotherapy sterilizes cancer in all cases with involved nodes.

6. Ackerman thought that simple mastectomy might spread cancer because

the surgeon would often be cutting through lymphatic disease. This hazard is surely even greater when the dissection and the handling of incised tissues are prolonged for hours, as it must be in the radical operation.

In short, Ackerman confirmed the fact that the Edinburgh patients had been treated for breast cancer, and accordingly that the remarkable five-year survival rate was attributable at least in part to more than the simple operation . . . *i.e.*, to the radical postoperative radiotherapy. He confirmed this fact and failed to mention any comparable unselected series of radically treated cases which had done so well.

ADDITIONAL COMMENTS

Carcinocidal Dosage: Many have questioned whether a tumor dose of about 4,000 rads in three weeks is carcinocidal for mammary cancer. We believe we have shown in our own material that it frequently can be (25). Richards (64) concluded he had shown it to be so in at least 35 per cent of his cases. McWhirter believes it is so in about 65 per cent of cases with his technic. The mere persistence of microscopic tumor cells in some heavily irradiated zones does not give a clue to their viability or potential lethality (24). Tissue culture or the passage of time would be necessary for such validation. In other words, morphology does not indicate degree of hazard (72). To date, the low five- and ten-year local recurrence rate supports the above contentions.

Nevertheless, this problem is uppermost in every radiotherapist's mind. We have previously discussed (28) the reasons for our belief that a tissue dose of 3,500 to 4,000 rads to a large volume in about three weeks time is carcinocidal or long-term suppressive for many breast cancers. We have noted in that paper the experimental and clinical evidence in support of this contention. It is believed, however, that with 200- to 300-kv beams this dose is close to the maximum safely tolerable. If it is to be protracted to four weeks, with increase in total dose (as McWhirter now does), its effectiveness will presumably diminish, and decreased local control of disease may be encountered. That such protraction will aid patient comfort goes without saying—as will the use of megavoltage or radiocobalt beams, if allowance is not made for the decreased relative biological effectiveness (RBE) of such. (Since the relative biological effectiveness of megavoltage —1 to 4 MEV—beams is believed to be about 0.75, corresponding increase in rads must be delivered.)

Treatment of Internal Mammary Nodes. A majority of investigators believe that when the internal mammary node chain is involved, most patients have vascular spread *via* the indirect drainage of that chain into the subclavian vein—in which case, excision or irradiation of the chain will not save the patient's life. On the contrary, too vigorous attack on the anterior mediastinum may lower the patient's general status and thereby decrease whatever degree of host resistance she possesses. Further, it is noteworthy that the five-year survival rate is almost as good in inner-quadrant as in outer-quadrant tumors. It is possible, therefore, that the nodes of the internal mammary chain, when invaded, are not *per se* as sinister a hazard as we have been inclined to assume, although clearly the persistence of malignant tissue anywhere in the body is undesirable.

If it could be established that the internal mammary chain was the only area of spread, *and that the disease was still confined to that area*, attempts at radical removal or destruction would be justifiable.[7] However, that such is unlikely is shown by Urban's careful work (74) which now discloses that out of some 70 cases treated by *en*

[7] INTERNAL MAMMARY BIOPSY IN CARCINOMA OF THE BREAST

	Inner Half	Outer Half	Total
Total cases	48	77	125
All examined nodes negative	10	30	40
Internal mammary only invaded	3	1	4
Axilla only invaded	6	28	34
Both internal mammary and axilla invaded	26	13	39

From Handley, 1952 (35).

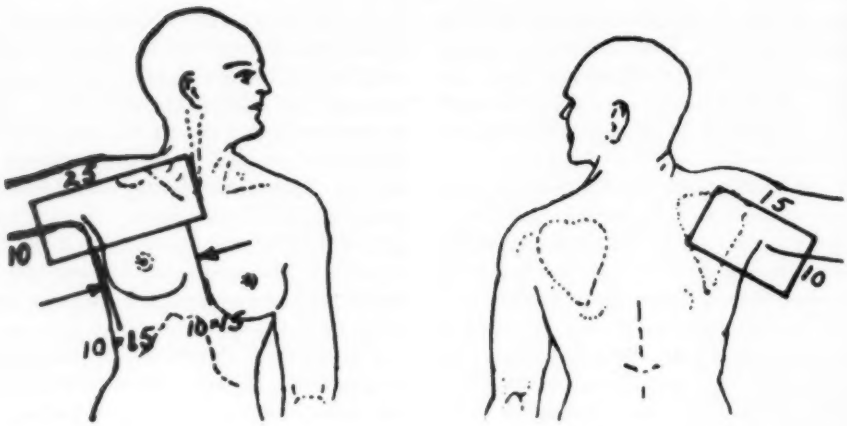


Fig. 17. Location of fields, 1948, McWhirter. Compare with Fig. 9 for current technic.

bloc removal of the chain along with the primary tumor, only 5 patients *who had microscopically proved internal mammary node involvement* have survived five years. It is not unreasonable to suspect that they might be in the slow-growing group which would have survived with nodes silent for such period. "When carcinoma has involved the nodes at the apex of the axilla, the supraclavicular nodes, or the internal mammary nodes in the first interspace, no conceivable form of surgical attack will succeed" (Haagensen). Some of the five- and ten-year survivors following radical mastectomy must, on the basis of the work of Handley and others, have had positive internal mammary nodes—untreated by either surgery or radiotherapy, but apparently dormant.

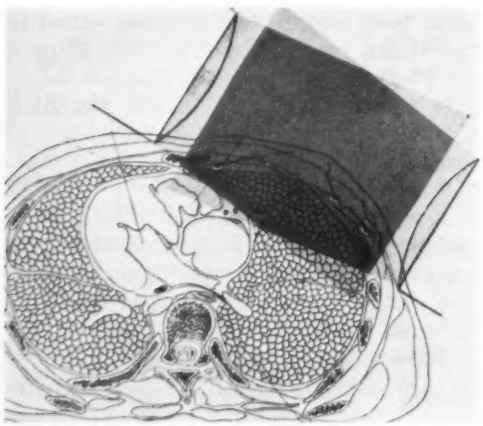


Fig. 18. Chest-wall fields drawn to scale on cross-section of torso 19 cm. thick. The distance between the curved ends of the tangential cones is 16 cm.; the distance from the edges of the cones where they touch the chest wall is 18 cm. It is evident that, with chests of greater thickness, the distance between the opposing fields may increase to an undesirable degree. The location of some of the nodes is shown.

The majority of McWhirter's survivors consist of patients treated prior to the realization of the frequency of internal mammary node involvement and some of these must be in a like group. The fact that the anterior mediastinal node area was not well irradiated in those cases is shown by the illustrations used in the earlier reports from Edinburgh.

Attempts to cross-fire the internal mammary chain in the chest-wall fields without (*a*) increasing the space between such fields above the desirable limit of 18 cm., or (*b*) including a large volume of lung tissue in the beam, are difficult. If the anterior beam is angled inward to irradiate the substernal area, its face ceases to parallel the lateral beam, and pulmonary irradiation increases. If it is not angled, the nodes in thick patients tend to be irradiated by the less efficient marginal zone of the beam.

In some patients, therefore, the internal mammary chain requires irradiation through a separate field. This must subtend the anterior shoulder field and be large enough to allow for normal slight variations in node location, *e.g.*, it should be

about 8 × 15 cm.; a minimal node dose of about 4,000 rads in four weeks is desirable.

Treatment During Pregnancy or Lactation: The pessimism concerning mammary cancer discovered in conjunction with pregnancy and lactation has been lightened by recent results published by Haagensen and others. McWhirter also noted significant salvage, obtaining five-year survivals in *39 per cent* of 36 women with lesions in Stages I to III. Adjunctive measures such as castration are indicated in some of these patients.

Preoperative Treatment: Several surgeons, notably Nohrman (57a), McNealy (49), Goode and Martin (32), Crile (18), and Atkins (7), and several radiotherapists, including Ash *et al.* (6) and Zuppinger and Renfer (78), present persuasive modern arguments and data in support of preoperative radiotherapy in *selected cases* of breast cancer, especially those with low fixed axillary nodes. As a precursor to some cases of radical mastectomy, the program has merit, but as an adjunct to simple mastectomy and postoperative irradiation it is not believed to be indicated.

Removal of the Uninvolved Breast: Routine prophylactic removal of the contralateral breast at time of, or shortly after, radical treatment of the primary is not warranted in the opinion of Farrow (23). His data show that only 1.7 per cent of over 5,000 patients studied at the Memorial Hospital would have been helped thereby.

Augmentation of Treatment: Extended efforts are in progress to augment the carcinocidal effects of irradiation, *e.g.*, by treatment in conjunction with increased oxygen supply to the tissues, by the use of "sensitizing" agents, and by conjoint chemotherapy (42). Data are not yet available to establish their value in human mammary cancer.

Results in Males: The arrest rate in males is notoriously poor. Nevertheless, the Edinburgh material shows that 29 per cent of 17 males with lesions in Stages I to III survived for five years, a notable result with McWhirter's technic.

Perspective: The serious long-term outlook for a majority of patients with mammary cancer should not deter us in our efforts to cure the curable minority, and treat as thoroughly and effectively as possible the remainder. The reason that some investigators see no significant curative benefits in treatment is presumably because very long-term statistics do not, in fact, reflect such. Of all women with breast cancer today, only a minority have biologically controllable disease at time of diagnosis, and of this group, in turn, only a portion are cared for by clinicians who attain the level of results indicated by the major statistics in this paper. By frank assessment of our own results in each area, and by diligence and persistence, we may attain the goal set by leaders such as Haagensen and McWhirter—in calm realization of the fact that it is usually the biologic type of tumor present, rather than the type of treatment applied, that decides the ultimate outcome. Our apparent successes are with the localized or the slow-growing lesions.

In the meantime, contemplating our struggle against disease as a whole, we may take encouragement from the improving death rate in general, shown so well by the data from the Metropolitan Life Statistical Bulletin for November 1956.

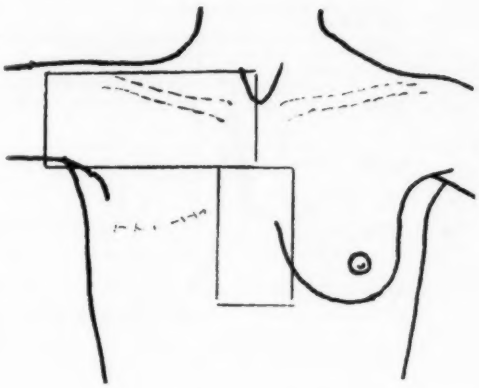


Fig. 19. Diagram showing internal mammary node field (approximately 8 × 15 cm. in this particular patient), subtending the anterior shoulder field. This is not used routinely in conjunction with the McWhirter technic.

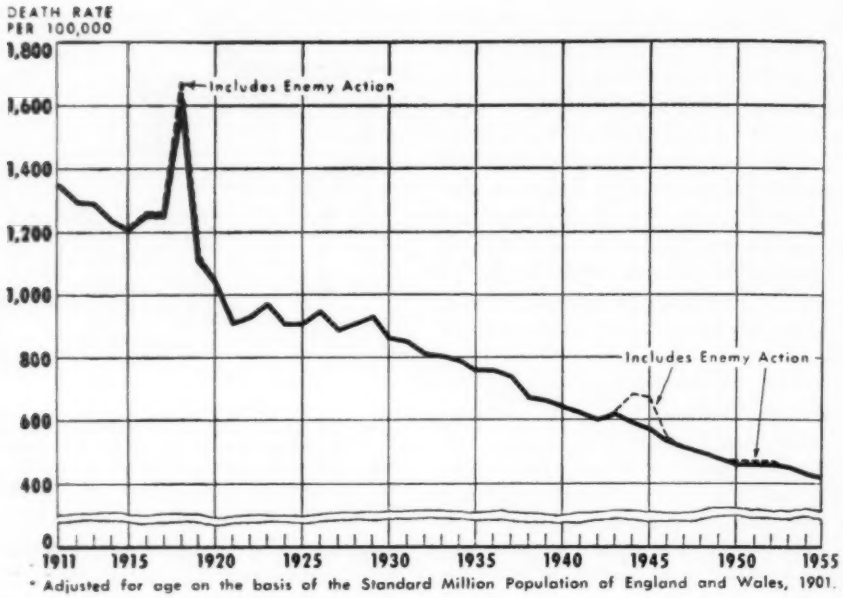


Fig. 20. Annual death rates from all causes (adjusted), ages 1 to 74 years, industrial policy holders, Metropolitan Life Insurance Company, 1911–1955. (Reproduced by permission)

SUMMARY

The preclinical phase of mammary cancer appears to be a relatively long one, *i.e.*, years, in most patients.

The clinical phase is usually manifest for several months before the average patient presents herself for treatment.

Calculated from the time of such presentation, the five-year *absolute* survival rate in *untreated* patients is approximately 13 per cent and the ten-year rate about 5 per cent.

By contrast, the five-year *absolute* survival rate in patients generally treated under a radical mastectomy program is approximately 35 per cent, and under a simple mastectomy plus radiotherapy program about 40 per cent.

The *relative* five-year survival rates in localized (Stage I and II) cases under the 2 programs are, respectively, approximately 53 per cent and 58 per cent. In other words, more than half of a group of women with "localized" lesions will survive five years with adequate treatment.

The ten-year and fifteen-year survival rates show steady attenuation, with late-appearing disease in chest wall and axilla apparently no more frequent under one program than the other, and distant metastases no less relentless in appearance.

The simple mastectomy plus radiotherapy program is applicable to a larger proportion of patients than the radical mastectomy program, has a lower morbidity rate, and provides generally better functional results.

The one group in which there has been room for valid therapeutic contention in the past consists of those few patients (some 10 to 14 per cent of all women with breast cancer) in whom removable axillary nodes constitute the *only* area of extramammary spread. The evidence now appears to indicate that radical axillary radiotherapy is as effective as axillary dissection in this group. Since it is somewhat more effective or preferable to surgery in the other groups, its general utilization appears to be warranted.

Simple mastectomy plus radiotherapy is not the answer to the breast cancer problem, which, lacking prevention, must depend

on viral, hormonal, or chemical developments. But until such answer is forthcoming, its place is now established alongside radical mastectomy as a forward step.

CONCLUSION

Each patient with mammary cancer should be assessed individually, and treatment instituted in accordance with the status of the patient, the clinical stage of the lesion, and the apparent biologic type of the tumor.

In general, Stage I to III cases should be treated by simple mastectomy and radical postoperative radiotherapy. Selected cases may better be treated by radical mastectomy or by radiotherapy alone. Some may not be in suitable condition for any treatment directed toward the breast lesion; such patients may have more serious disease involving other structures in the body.

Most Stage IV cases should be treated by radiotherapy or hormone therapy.

In Stages I to III, if the disease has already spread into the axilla, radical surgery may serve only to disseminate it still further. If disease is still confined to the breast, dissection of the axilla is unnecessary. If the tissues are not disturbed by operation, and are exposed to adequate irradiation, tumor cells will be either destroyed or rendered inactive for long periods of time. The frequency of simultaneous invasion of the internal mammary chain, and its inaccessibility to removal by the standard radical procedure, lends strength to this program.

The conservative program permits a survival rate slightly higher than that generally associated with radical operation, a lower operative mortality, and a better functional result.

ACKNOWLEDGMENT: The author acknowledges gratefully the assistance given him by his associates, the referring surgeons, the consulting pathologists, and last but not least the resident staff at the San Francisco, St. Joseph, and Letterman Hospitals. To name all would be impossible—to name a few invidious. The services of our Tumor Board and Registry secretaries were made available through the generous assistance of the American Cancer Society, California Division.

REFERENCES

1. ACKERMAN, L. V.: An Evaluation of the Treatment of Cancer of the Breast at the University of Edinburgh (Scotland), Under the Direction of Dr. Robert McWhirter. Cancer **8**: 883–887, September-October 1955.

2. ACKERMAN, L. V., AND DEL REGATO, J. A.: Cancer: Diagnosis, Treatment, and Prognosis. St. Louis, C. V. Mosby Co., 1947.

3. ACKERMANN, W.: Vertebral Trephine Biopsy. Ann. Surg. **143**: 373–385, March 1956.

4. ADAIR, F. E.: Cancer of Breast. S. Clin. North America **33**: 313–327, April 1953.

5. ANDREASSEN, M., AND DAHL-IVERSEN, E.: Recherches sur les métastases microscopiques des ganglions lymphatiques sus-claviculaires dans le cancer du sein: Recherches histologiques de 98 cas opérés radicalement. J. internat. chir. **9**: 27–40, January-February 1949.

6. ASH, C. L., PETERS, V., AND DELARUE, N. C.: Argument for Preoperative Radiation in Treatment of Breast Cancer. Surg., Gynec. & Obst. **96**: 509–521, May 1953.

7. ATKINS, H. J.: Cancer of the Breast. J. Roy Coll. Surgeons Edinburgh **1**: 253–267, June 1956.

8. BATSON, O. V.: The Vertebral Vein System. Am. J. Roentgenol. **78**: 195–212, August 1957.

9. BLOOM, H. J. G.: The Role of Histology in the Treatment of Breast Cancer. Brit. J. Radiol. **29**: 488–497, September 1956.

10. BROWN, P.: The Inception and Development of Fluoroscopy: The Influence of Carman on Its Status in America. Radiology **38**: 414–425, April 1942.

11. BUDD, J. W.: Personal communication, September 1957.

12. CALIFORNIA, STATE OF, DEPT. OF PUB. HEALTH: Personal communication, June 28, 1957.

13. CHAMBERLAIN, W. E.: Fluoroscopes and Fluoroscopy. Carman Lecture. Radiology **38**: 383–413, April 1942.

14. CLARKE, K. H.: A System of Dosage Estimation for the Tangential Irradiation of the Breast Without Bolus. Brit. J. Radiol. **23**: 593–597, October 1950.

15. CLARKSON, J. R.: A Note on Tangential Irradiation Without the Use of Bolus Packing. Brit. J. Radiol. **22**: 173–176, March 1949.

16. COLLINS, V. P., ET AL.: Observations on Growth Rates of Human Tumors. Am. J. Roentgenol. **76**: 988–1000, November 1956.

17. COUTARD, H.: Zusammenfassung der Grundlagen der röntgentherapeutischen Technik der tiefgelegenen Krebse. Strahlentherapie **37**: 50–58, 1930.

18. CRILE, G., JR.: Factors Influencing the Spread of Cancer. Surg., Gynec. & Obst. **103**: 342–352, September 1956.

19. DALAND, E. M.: Untreated Cancer of the Breast. Surg., Gynec. & Obst. **44**: 264–268, February 1927.

19-a. DALAND, E. M.: Incidence of Swollen Arms After Radical Mastectomy and Suggestions for Prevention. New England J. Med. **242**: 497–502, March 30, 1950.

20. DEATON, W. R., JR.: Simple Mastectomy for Carcinoma of Breast—Reported Results. Surgery **37**: 720–725, May 1955.

21. DORN, H. F., AND CUTLER, S. J.: Morbidity from Cancer in the United States. Variations in Incidence by Age, Sex, Race, Marital Status, and Geographic Region. Public Health Monogr. No. 29. Washington, D. C., Govt. Print. Off., 1955.

22. ENGELL, H. C.: Cancer Cells in the Circulating Blood: A Clinical Study on the Occurrence of Cancer Cells in the Peripheral Blood and in Venous Blood Draining the Tumour Area at Operation. Acta chir. scandinav. supp. 201, 1955.

23. FARROW, J. H.: Bilateral Mammary Cancer. Cancer **9**: 1182–1188, November-December 1956.

24. FRIEDMAN, M., AND PEARLMAN, A. W.: Time-Dose Relationship in Irradiation of Recurrent Cancer of the Breast: Iso-Effect Curve and Tumor Lethal Dose. Am. J. Roentgenol. **73**: 986–998, June 1955.

25. GARLAND, L. H.: Experiences with Radiotherapy in the Treatment of Breast Cancer. Proceedings of the Third National Cancer Conference, 1956. Philadelphia, J. B. Lippincott Co., 1957.

26. GARLAND, L. H., HILL, H. A., MOTTRAM, M. E., AND SISSON, M. A.: Cancer of the Breast: Results of Radical Mastectomy and Radiotherapy in Two Hospitals. Surg., Gynec. & Obst. **98**: 700–704, June 1954.

27. GARLAND, L. H., BAKER, M., PICARD, W. H., JR., AND SISSON, M. A.: Roentgen and Steroid Hormone Therapy in Mammary Cancer Metastatic to Bone; Council on Pharmacy and Chemistry. J.A.M.A. **144**: 997–1004, Nov. 18, 1950.

28. GARLAND, L. H.: Rationale and Results of Simple Mastectomy Plus Radiotherapy in Primary Cancer of the Breast. Am. J. Roentgenol. **72**: 923–941, December 1954.

29. GATCH, W. D., AND CULBERTSON, C. G.: Theories on Treatment of Breast Cancer and Observations on its Natural Course. Ann. Surg. **135**: 775–781, June 1952.

30. GIL Y GIL: Le rôle du tissu osseux spongieux dans la dissémination néoplasique. J. de radiol. et d'électrol. **32**: 573–576, 1951.

31. GOCHT, H.: Therapeutische Verwendung der Röntgenstrahlen. Fortschr. a. d. Geb. d. Röntgenstrahlen **1**: 14–22, 1897.

32. GOODE, J. V., AND MARTIN, J. A.: Surgical Experience with Mammary Cancer: Growth Characteristics Observed During Treatment of 258 Private Patients with Breast Cancer. Ann. Surg. **137**: 856–863, June 1953.

33. HAAGENSEN, C. D.: Diseases of the Breast. Philadelphia, W. B. Saunders Co., 1956.

34. HALSTED, W. S.: The Treatment of Wounds with Especial Reference to the Value of the Blood Clot in the Management of Dead Spaces. Johns Hopkins Hosp. Rep. **2**: 255–314, 1890–1891.

35. HANDLEY, R. S.: Further Observations on Internal Mammary Lymph Chain in Carcinoma of Breast. Proc. Roy Soc. Med. **45**: 565–566, August 1952.

36. HARRINGTON, S. W.: Results of Surgical Treatment of Unilateral Carcinoma of Breast in Women. J.A.M.A. **148**: 1007–1011, March 22, 1952.

37. HICKEY, R. C., ET AL.: Cancer of the Breast: 1661 Patients. I. Considerations in Future Therapy. Arch. Surg. **73**: 654–660, October 1956.

38. HOLMAN, C. C.: Cancer of the Breast: Principles of Surgical Treatment. Lancet **1**: 174–176, Jan. 23, 1954.

39. HOPKINS, G. G.: Light and Radiance in the Treatment of Disease. Philadelphia M. J. **8**: 404, 1901.

40. JESSIMAN, A. G., AND MOORE, F. D.: Carcinoma of the Breast: The Study and Treatment of the Patient. Boston, Little, Brown & Co., 1956.

41. JONES, H. B.: Demographic Consideration of the Cancer Problem. Tr. New York Acad. Sc. **18**: 298–333, February 1956.

42. KLIGERMAN, M. M., AND SHAPIRO, D. M.: Augmentation of Radiotherapeutic Effect by Cancer Chemotherapy. Radiology **69**: 194–199, August 1957.

43. LEES, T. W.: Assessing the Curability of Cancer. Acta radiol. supp. 132, 1956.

44. LEVIN, M.: Cited by Adair (4).

45. LEWISON, E. F.: Breast Cancer and Its Diagnosis and Treatment. Baltimore, Williams & Wilkins Co., 1955.

46. LOCHMAN, D. J.: Dosage in Tangential Radiation Therapy of the Postoperative Breast Portal. Am. J. Roentgenol. **73**: 803–812, May 1955.

47. LOMBARD, H. I.: [In]: Physiopathology of Cancer, ed. by F. Homburger and W. H. Fishman. New York, Paul B. Hoeber, Inc. 1954.

48. MACDONALD, I.: Indications of the Fundamental Biology of Mammary Cancer. Proceedings of the Third National Cancer Conference, 1956. Philadelphia, J. B. Lippincott Co., 1957.

49. MCNEALY, R. W.: Management of Breast Tumors. Mississippi Valley M. J. **66**: 5–7, January 1944.

50. MCWHIRTER, R.: The Value of Simple Mastectomy and Radiotherapy in the Treatment of Cancer of the Breast. Brit. J. Radiol. **21**: 599–610, December 1948.

51. MCWHIRTER, R.: Treatment of Cancer of Breast by Simple Mastectomy and Roentgenotherapy. Arch. Surg. **59**: 830–842, October 1949.

52. MCWHIRTER, R.: The Treatment of Carcinoma of the Breast. Irish J. M. Sc., pp. 475–483, November 1956.

53. MCWHIRTER, R.: Some Factors Influencing Prognosis in Breast Cancer. J. Fac. Radiologists **8**: 220–234, April 1957.

54. MEYER, A. C., AND SMITH, S. S.: Some Concepts in the Treatment of Breast Cancer. Arch. Surg. **69**: 707–710, November 1954.

55. MOORE, G. E.: Triethylenethiophosphoramide in the Treatment of Cancer. Roswell Park Bull. **2**: 31–40, 1957.

56. MUSTAKALLIO, S.: Treatment of Breast Cancer by Tumour Extirpation and Roentgen Therapy Instead of Radical Operation. J. Fac. Radiologists **6**: 23–26, July 1954. Also, Personal communication, July 1957.

57. NELSON, A. J. M.: Results of Treatment of Cancer of Lip, Mouth and Tongue, and of Breast. M. J. Australia **1**: 34–42, Jan. 8, 1955.

57-a. NOHRMAN, B. A.: Cancer of Breast: Clinical Study of 1042 Cases Treated at Radiumhemmet, 1936–1941. Acta radiol. supp. 77, 1949. Cited by Garland (28).

58. PARK, W. W., AND LEES, J. C.: Absolute Curability of Cancer of Breast. Surg., Gynec. & Obst. **93**: 129–152, August 1951.

59. PIERCE, E. H., KIRKLIN, J. W., MCDONALD, J. R., AND GAGE, R. P.: Carcinoma in the Medial and Lateral Halves of the Breast. Surg., Gynec. & Obst. **103**: 759–764, December 1956.

60. PORTMANN, U. V.: [In]: The Science of Radiology, ed. by O. Glasser. Springfield, Ill., Charles C Thomas, 1933.

61. PRICE, P. B.: Spread of Mammary Carcinoma. J.A.M.A. **159**: 1345–1347, Nov. 26, 1955.

62. PUSEY, W. A., AND CALDWELL, E. W.: The Practical Application of the Röntgen Rays in Therapeutics and Diagnosis. Philadelphia, W. B. Saunders Co., 1903.

63. QUEENSLAND RADIUM INSTITUTE: Annual Report, 1955–1956. Brisbane, Australia.

64. RICHARDS, G. E.: Mammary Cancer: The Place of Surgery and of Radiotherapy in Its Management. Part I. A Study of Some of the Factors Which Determine Success or Failure in Treatment. Brit. J. Radiol. **21**: 109–127, March 1948.

65. RIGLER, L.: Personal communication, August 1957.

66. SAPHIR, O., AND AMROMIN, G. D.: Obscure Axillary Lymph-Node Metastasis in Carcinoma of Breast. Cancer **1**: 238–241, July 1948.

67. SCHENKEN, J. R., ET AL.: Incidence of Metastatic Cancer in Axillary Lymph Nodes. A. M. A. Section on Pathology, N. Y., June 5, 1957.

68. SCHREK, R.: Fifty Per Cent Survival Time As a

Measure of Prognosis in Cancer. Am. J. Clin. Path. **26:** 172–174, February 1956.

69. SCOTT, W. G.: The Development of Angiocardiography and Aortography. Carman Lecture. Radiology **56:** 485–518, April 1951.

70. SHIMKIN, M. B., LUCIA, E. L., STONE, R. S., AND BELL, H. G.: Cancer of Breast: Analysis of Frequency, Distribution, and Mortality at University of California Hospital, 1918 to 1947, Inclusive. Surg., Gynec. & Obst. **94:** 645–661, June 1952.

71. SMALL, R. G., AND DUTTON, A. M.: Survival of Patients with Carcinoma of the Breast. J.A.M.A. **157:** 216–219, Jan. 15, 1955.

72. SMITHERS, D. W., RIGBY-JONES, P., GALTON, D. A. G., AND PAYNE, P. M.: Cancer of the Breast: A Review. Brit. J. Radiol. supp. no. 4, 1952.

73. STEWART, F. W.: Tumors of the Breast. Fascicle 34, Armed Forces Inst. Path., Washington, D. C., 1950.

74. URBAN, J. A.: Clinical Experiences with Internal Mammary Lymph Node Chain in Breast Cancer. A. M. A. Section on Pathology, N. Y., June 5, 1957.

75. WATSON, T. A.: Results of Treatment of Cancer of the Breast. Surg., Gynec. & Obst. **104:** 106–112, January 1957.

76. WILLIAMS, I. G., MURLEY, R. S., AND CURWEN, M. P.: Carcinoma of Female Breast: Conservative and Radical Surgery. Brit. M. J. **2:** 787–796, Oct. 10, 1953.

77. WILLIS, R. A.: Pathology of Tumours. St. Louis, C. V. Mosby Co., 1948.

78. ZUPPINGER, A., AND RENFER, H. R.: Die Röntgenvorbestrahlung. Radiol. clin. **25:** 384–408, November 1956.

450 Sutter St.
San Francisco 8, Calif.

SUMMARIO IN INTERLINGUA

Le Tractamento De Cancere Del Mamma. Le Conferentia Carman

Un revista comprehensive del thema de cancere mammari super le base del material disponibile in le litteratura recente, in statisticas governamental, e in le experientia personal del autor ha ducite al sequente observationes:

Le phase preclinic de cancere mammari pare esser relativemente longe, *i.e.*, annos, in le majoritate del patientes. Le phase clinic es usualmente manifeste durante plure menses ante que le patiente typic se presenta pro esser tractate.

Calculate ab le tempore del presentation, le quintenne superviventia *absolute* in patientes *non-tractate* es approximativemente 13 pro cento; le decenne superviventia, approximativemente 5 pro cento. Per contrasto con isto, le quintenne superviventia *absolute* in patientes qui recipe un tractamento general sub un programma de mastectomia radical es approximativemente 35 pro cento; sub un programma de mastectomia simple con radiotherapia, approximativemente 40 pro cento.

Le *relative* superviventia quintenne in casos localisate (stadios I e II) sub le duo programmas es, respectivemente, circa 53 e 58 pro cento. In altere parolas, plus que un medietate del feminas in un gruppo con lesiones "localisate" supervive cinque annos in le presentia de un therapia adequate.

Le superviventias decenne e dece-quintenne monstra un attenuation constante, e le apparition tardive del morbo in le pariete thoracic e in le axilla es apparentemente non plus frequente sub le un que sub le altere programma, e le apparition de metastases distante ha le mesme grado de irresistibilitate.

Le programma de mastectomia simple con radiotherapia es applicabile a un plus grande proportion de patientes que le programma de mastectomia radical; illo ha un plus basse incidentia de morbiditate e produce generalmente melior resultatos functional.

Le sol gruppo pro que il existeva in le passato un base valide de dissentimento therapeutic consiste del pauco numerose patientes (circa 10 a 14 pro cento de omne feminas con cancere mammari) in qui excidibile nodos axillar constitue le unic area de extension extramammari. Le evidentia nunc pare indicar que in iste gruppo, radical radiotherapia axillar es tanto efficace como dissection axillar. Proque illo es alique plus efficace que le intervention chirurgic (o preferibile a illo) in altere gruppos de patientes, su utilisation general pare esser justificate.

Mastectomia simple con radiotherapia non es le responsa final al problema de cancere mammari. In le absentia de mesuras preventive, le responsa al problema debe esser cercate in futur disveloppamentos virusal, hormonal, o chimic. Sed usque tal disveloppamentos es effectuate, mastectomia simple con radiothera-

pia ha un placia establite juxta le mastectomia radical como un passo in avante.

Super iste bases le sequente conclusiones pote esser formulate:

Omne patiente con cancere mammari debe esser evalutate individualmente, e le tractamento debe esser instituite de accordo con le stato del patiente, le stadio clinic del lesion, e le apparente typo biologic del tumor.

In general, casos del stadios I a III debe esser tractate per mastectomia simple con radical radiotherapia postoperatori. Certe casos seligite es forsan a tractar preferibilemente per mastectomia radical o radiotherapia sol. Certe alteres se trova possibilemente non in un condition que permitte ulle tractamento dirigite contra le lesion mammari proque un plus serie morbo es presente que affice altere structuras del corpore. Le majoritate del casos de stadio IV debe esser tractate per radiotherapia o per therapia hormonal.

In stadios I a III, si le morbo se ha jam extendite a in le axilla, il es possibile que un chirurgia radical resulta solmente in un dissemination additional. Si le morbo es ancora restringite al mamma, dissection del axilla es innecessari. Si le histos non es disturbate per le operation e si illos es exponite a un irradiation adequate, le cellulas tumorose es destruite o illos es rendite inactive pro longe periodos de tempore. Le frequentia de invasiones simultanee del interne catena mammari e su inaccessibilitate per standard technicas de ablation radical supporta le valor de iste programma.

Le programma conservatori permitte un superviventia levemente plus alte que illo generalmente associate con operationes radical. Su mortalitate operatori es plus basse, e su resultatos functional es melior.

Idiopathic Pulmonary Hemorrhage with Hemosiderosis and Microcytic Anemia[1]

ERNEST L. SCHOENIGER, M.D., ARTHUR S. TUCKER, M.D., and ROBERT P. BOLANDE, M.D.

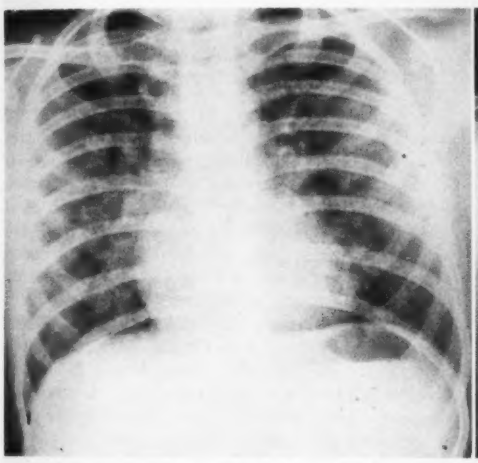
THE RADIOLOGIST is in a position to make a significant contribution to the explanation of hemoptysis in some patients if he is aware of the characteristic pattern of idiopathic pulmonary hemorrhage. In Europe the condition has been called the Ceelen-Gellerstedt syndrome; in the United States it has most frequently been described as idiopathic pulmonary hemosiderosis.

The first description of the pathologic findings was made by Virchow more than a century ago. Ceelen reported on the autopsies of 2 cases in 1921 (5). Waldenström in 1938 correlated the clinical with the pathological picture (12). Recently the reports have been more numerous, and at present approximately 60 cases have been described, most of them with autopsy documentation. According to these reports, the disease usually is fatal within a few years. However, several patients have been reported as being alive several years after the diagnosis was made (2, 7, 9).

CASE REPORT

M. C. S., a 9-year-old white girl, was admitted to Babies and Childrens Hospital on March 25, 1953, because of expectoration of small amounts of blood-streaked sputum for three or four days. For several months before admission she had been experiencing low-grade fever with frequent respiratory infections, for which she had been treated repeatedly with sulfonamides and antibiotics. A chest roentgenogram made elsewhere two months previously was reported to be normal.

The admission rectal temperature was 37.6° C., pulse 120, respirations 24. The patient appeared pale but not acutely ill. The physical examination, including the heart and lungs, was otherwise normal.



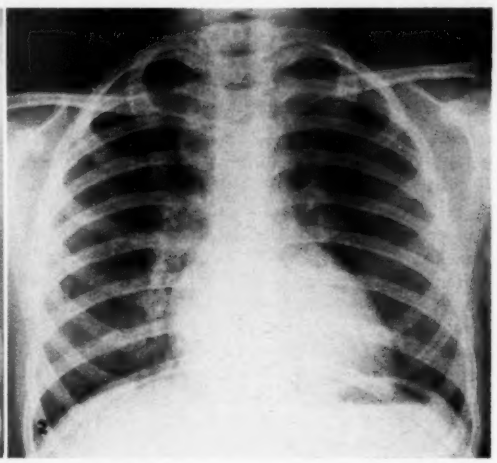


Fig. 1. Chest film, March 26, 1953, showing bilateral diffuse patchy densities.
Fig. 2. Chest film, April 14, 1953, demonstrating some residual patches, though the lungs are much clearer than on the initial examination.

The blood showed a hemoglobin of 8.6 gm. per cent, a hematocrit of 30 per cent, and 0.4 per cent reticulocytes. The white count was 4,100, with a normal differential, including 2 per cent eosinophils. Other laboratory tests, including sedimentation rate, cold agglutinins, febrile agglutinins, heterophil reaction, tuberculin reactions, bleeding and clotting times, serum proteins, stool guaiac examinations, and routine sputum cultures, gave normal results. No acid-fast bacilli were found in the sputum.

The postero-anterior chest roentgenogram showed

[1] From the Departments of Radiology and Pathology, The University Hospitals of Cleveland, and Western Reserve University School of Medicine. Accepted for publication in July 1957.

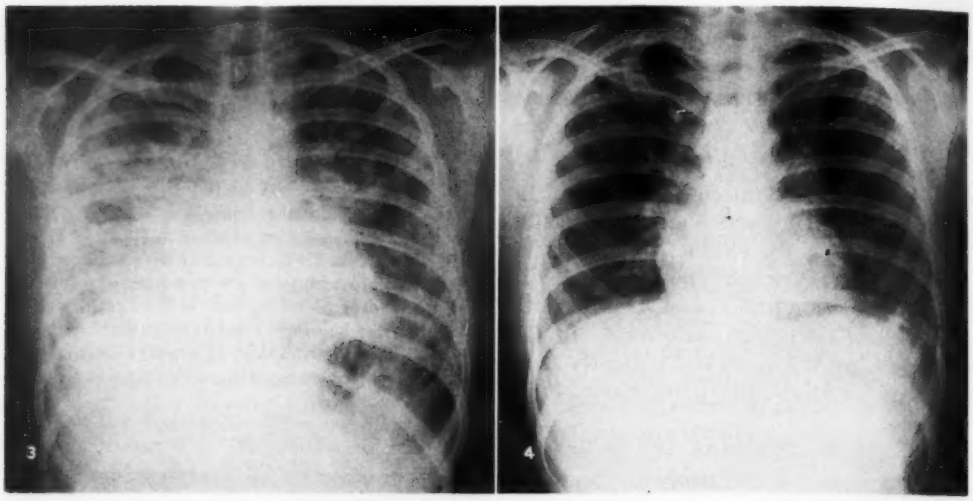


Fig. 3. Chest film, March 6, 1956, showing marked recrudescence of lung infiltration.
Fig. 4. Chest film, March 19, 1956. The lung fields have cleared.

streaky and mottled fine densities, diffusely distributed throughout the lungs, but with a tendency to coalescence (Fig. 1). During one week in the hospital the course was mildly febrile (maximum temperature 38° C.) and slight hemoptysis continued. One unit of whole blood was given, and the patient was discharged with a hemoglobin of 11.2 gm. per cent and hematocrit of 35 per cent.

A few days later the child was readmitted for bronchoscopy and bronchography. Both studies were normal. A postero-anterior roentgenogram obtained nineteen days after the original examination revealed a marked degree of improvement (Fig. 2).

A third admission occurred on June 29, 1953, following another episode of hemoptysis and fever. After one week the patient improved, without specific therapy, and was discharged. She remained relatively asymptomatic for nearly three years. In March 1956, however, she was again admitted after coughing up blood and running a fever for three days. Her rectal temperature was 38.8° C., pulse 140, and respirations 40. The appearance was that of a moderately acutely ill child. The nail beds appeared slightly cyanotic. Scattered râles and rhonchi were heard throughout the lungs. Otherwise the physical examination was not remarkable. The chest film showed a marked degree of bilateral pulmonary infiltration of the same nature as that found on the original examination but considerably more extensive. The hili were also prominent (Fig. 3). The hematocrit at this time was 33 per cent, and the reticulocyte count was 3 per cent. The white blood count ranged from 4,200 to 7,400. Studies on this admission included a lupus erythematosus preparation, direct and indirect Coombs' tests, C-reactive protein determinations, and multiple blood cultures, all of which were negative. The icteric index was 7. The electrocardiogram was normal. For three days the patient ran a febrile course, with a maximum temperature of 40° C., but on the fourth day, with only supportive therapy, the fever subsided. The chest film became normal (Fig. 4), and on the twenty-first day the patient was discharged.

The final admission occurred Oct. 16, 1956, after one day of fever and sore throat. A throat culture showed no streptococci. Two hours before admission hemoptysis commenced and became progressively more severe. Upon arrival at the emergency ward the patient was pulseless, bleeding was profuse from nose and mouth, and heart sounds were inaudible. The attending physician estimated the blood loss by hemoptysis at several pints. Cardiac massage was unsuccessful. At the same time several pints of blood were administered rapidly, but the patient died from shock within one hour.

Autopsy: The mouth, nose, trachea, and bronchi were filled with bloody fluid. No other abnormalities of the major intra- or extrapulmonary air passages were present. The pleural surfaces were glistening, without adhesions, and presented a reddish-brown appearance mottled with dark reddish-blue subpleural hemorrhages. The left lung weighed 870 gm., the right lung 970 gm. Both lungs contained numerous dark red foci, 1 to 3 cm. in diameter, which on section were seen to be areas of recent hemorrhage. The lung parenchyma was firm and reddish-brown throughout. The heart was not remarkable and was of normal size. The liver weighed 1,800 gm. and appeared markedly congested. The kidneys were pale, and the left bore a depressed cortical scar.

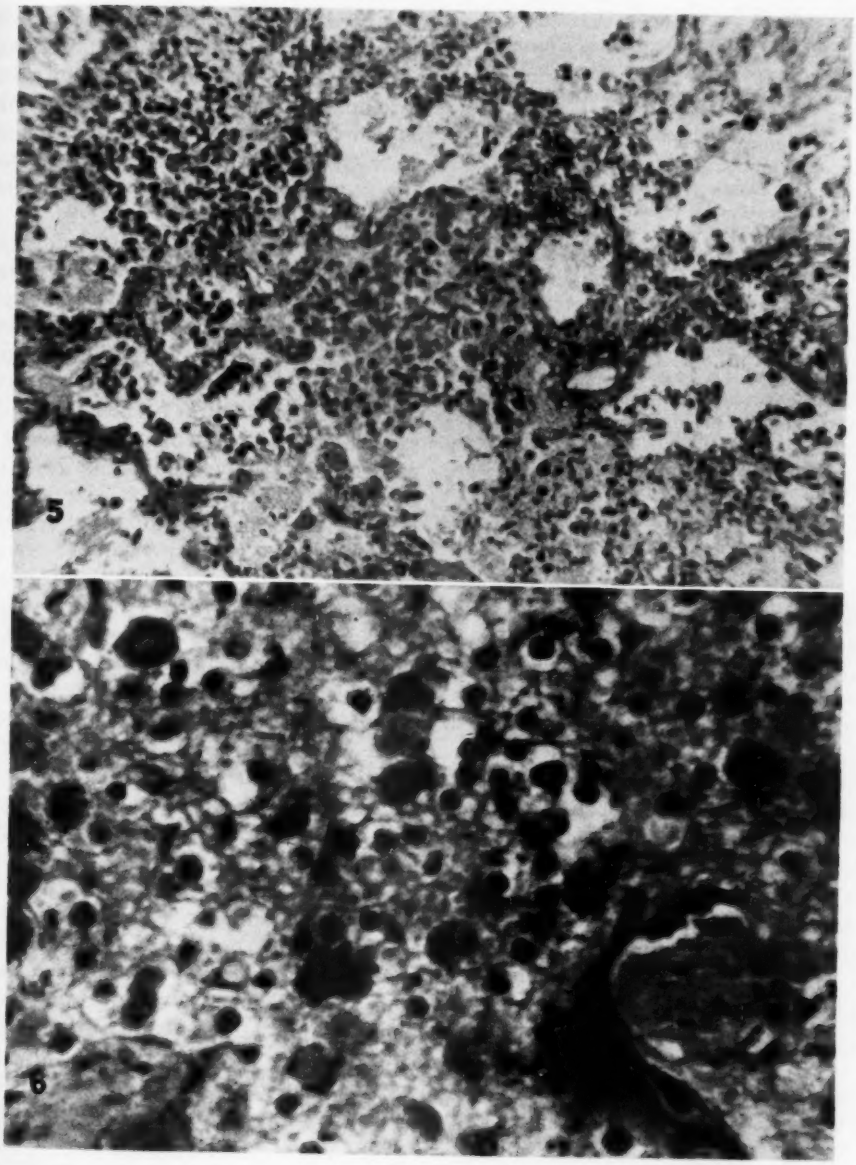


Fig. 5. Section of lung at low power. The alveoli are thickened and fibrotic. Their lumina contain numerous dark hemosiderin-laden macrophages, free hemosiderin, and precipitated proteinaceous fluid. Pigmented macrophages may be seen in interstitial fibrous connective tissue. Hematoxylin-eosin.

Fig. 6. Sections of alveolar exudate at high power. The dark pigment granules may be seen in the cytoplasm of macrophages. Lymphocytes and occasional polymorphonuclear leukocytes are embedded in a matrix of protein-rich fluid. Hematoxylin-eosin.

On microscopic examination, a chronic mucosal tracheitis was found, with submucosal accumulation of hemosiderin-laden macrophages. Hemosiderin deposition of moderate to marked degree was found in the hilar lymph nodes. Sections of the lungs showed diffuse recent intra-alveolar hemorrhages. A large amount of yellowish-brown hemosiderin pigment was present, both free and within alveolar

macrophages. The free form was deposited on the luminal surfaces of the alveoli, forming a membrane. Pigment-laden macrophages were also found within the perivascular and interstitial connective tissue of the alveolar septa. These septa were markedly thickened with an eosinophilic fibro-hyaline connective tissue which was positive with periodic acid-Schiff staining. Elastic tissue stains showed thickening and duplication of elastic fibers within the septa. Metachromasia was not found with toluidine blue. Focal areas of polymorphonuclear exudation and bacterial colonization were present. The spleen and liver showed moderate congestion and hemosiderin deposition within reticuloendothelial cells.

The final pathologic diagnoses were: (*a*) idiopathic pulmonary hemosiderosis with recent and remote intra-alveolar hemorrhage; (*b*) diffuse interstitial pulmonary fibrosis, moderate; (*c*) focal acute pneumonitis with bacterial colonization (Figs. 5 and 6).

DISCUSSION

Idiopathic pulmonary hemorrhage usually occurs in children. In about 20 of the 60 reported cases, however, the patients were older than fifteen years (14).

The etiology of the disease is obscure. Various theories have been submitted. Congenital defects of the elastica of the blood vessel wall and congenital lesions in the lesser circulation have been implicated. Perhaps the most plausible explanation is based on an allergic mechanism (11).

The symptomatology is almost always the same. Hemoptysis is invariably present, usually in small quantities at first. The patients progress to tachypnea, dyspnea, pallor, tachycardia, low fever, slight cyanosis, and ultimately jaundice. The iron-deficiency anemia is striking. Auscultatory signs are few, or absent altogether. In progressive disease, clubbing of the fingers may be found, and cor pulmonale and heart failure ensue.

Roentgenographically the appearance usually is characteristic. Mottled fine densities are seen in a miliary or patchy distribution. Hodson emphasizes three roentgenographic criteria: multiple pulmonary consolidations, which clear in a week or so, changing patterns of coalescence, and an underlying reticulostriate pattern (8). At times hilar enlargement and cardiomegaly may supervene. With our patient the roentgenographic findings correlated well with the timing and severity of the clinical attacks. Others have reported resolution and sometimes complete disappearance of the abnormal markings in the lungs following subsidence of the acute episodes.

The finding of diffuse mottled densities in the chest roentgenogram of a young person with hemoptysis should make the radiologist consider idiopathic pulmonary hemorrhage. Other conditions which produce a similar roentgenographic picture, such as heart failure, periarteritis nodosa, sarcoidosis, and pneumoconiosis, are not associated with hemoptysis or have other diagnostic features which should permit differentiation from idiopathic pulmonary hemorrhage. Miliary tuberculosis does occur in young individuals, but is not a cause of hemoptysis (6).

Laboratory findings are usually not helpful in diagnosis, except to document the microcytic hypochromic anemia and to demonstrate pigment-laden macrophages in the sputum. Other hematologic studies, such as bleeding and clotting times, platelet count, and osmotic fragility, are normal. Many authors have reported elevated reticulocyte counts.

The acute episodes of hemorrhage usually continue for several days and then subside spontaneously. The patients are benefited temporarily by oral iron medication, steroid therapy, and transfusion(9). According to most reports, the course of the disease permits survival of but a few years. In the Mayo Clinic experience with 31 cases, 6 patients lived less than one year, and 25 less than five years (4). Brooks has suggested that milder cases may occur, and that recovery may be much commoner than one would realize from the reports in the literature (2). According to these, the terminal episode is usually cardiorespiratory. Massive hemoptysis and pneumonia have also been described as causes of death. This was the case with our patient.

Postmortem findings of significance are

confined almost entirely to the lungs. These are uniformly heavy, weighing four to five times the normal. They are reddish-brown and firm. On section, red hepatization is seen. The tracheobronchial nodes are enlarged and often contain hemosiderin. Upon microscopic examination the alveolar walls are found to be thickened. Hemosiderin is present in large amounts in the alveoli and their walls and throughout the entire bronchial tree, either in the form of free granules or within macrophages.

SUMMARY

A female patient was followed from nine years until death at twelve years from idiopathic pulmonary bleeding with hemosiderosis. The characteristic roentgen pattern is shown, as well as the autopsy findings. The diagnosis should be considered in all young patients with hemoptysis who present a diffusely mottled pulmonary infiltrate which changes, clears, and recurs.

ACKNOWLEDGMENT: The authors express their appreciation to Dr. T. W. Moir for his guidance in the preparation of this report on his patient.

Arthur S. Tucker, M.D.
University Hospitals of Cleveland
2065 Adelbert Road
Cleveland 6, Ohio

REFERENCES

1. ANSPACH, W. E.: Pulmonary Hemosiderosis. Am. J. Roentgenol. **41**: 592–596, April 1939.
2. BROOKS, W. D. W.: Cited by Hodson (8).
3. BROWNING, J. R., AND HOUGHTON, J. D.: Idiopathic Pulmonary Hemosiderosis. Am. J. Med. **20**: 374–382, March 1956.
4. BRUWER, A. J., KENNEDY, R. L. J., AND EDWARDS, J. E.: Recurrent Pulmonary Hemorrhage with Hemosiderosis: So-Called Idiopathic Pulmonary Hemosiderosis. Am. J. Roentgenol. **76**: 98–107, July 1956.
5. CEELEN, W.: Die Kreislaufstörungen der Lungen. [In]: Henke-Lubarsch: Handbuch der speziellen pathologischen Anatomie und Histologie. Berlin, J. Springer, 1931, Vol. III/3, pp. 20–24.
6. ELGENMARK, O., AND Kjellberg, S. R.: Hemosiderosis of the Lungs—Typical Roentgenological Findings. Acta radiol. **29**: 32–36, 1948.
7. FLEISCHNER, F. G., AND BERENBERG, A. L.: Idiopathic Pulmonary Hemosiderosis. Radiology **62**: 522–526, April 1954.
8. HODSON, C. J., FRANCE, N. E., AND GORDON, I.: Idiopathic Juvenile Pulmonary Haemosiderosis. J. Fac. Radiologists **5**: 50–61, July 1953.
9. IRVIN, J. M., AND SNOWDEN, P. W.: Idiopathic Pulmonary Hemosiderosis: Report of a Case with Apparent Remission from Cortisone. J. Dis. Children **93**: 182–187, February 1957.
10. SCHAAR, F. E., AND RIGLER, L. G.: Idiopathic Pulmonary Hemosiderosis. Essential Brown Induration of the Lung. Report of a Case and Review of Literature. Journal-Lancet **76**: 126–134, May 1956.
11. STEINER, B.: Essential Pulmonary Haemosiderosis as an Immuno-Haematological Problem. Arch. Dis. Childhood **29**: 391–397, October 1954.
12. WALDENSTRÖM, J.: Relapsing, Diffuse, Pulmonary Bleedings or Hemosiderosis Pulmonum—A New Clinical Diagnosis. Acta radiol. **25**: 149–162, 1944.
13. WYLLIE, W. G., SHELDON, W., BODIAN, M., AND BARLOW, A.: Idiopathic Pulmonary Haemosiderosis (Essential Brown Induration of the Lungs). Quart. J. Med. **17**: 25–48, January 1948.
14. WYNN-WILLIAMS, N., AND YOUNG, R. D.: Idiopathic Pulmonary Haemosiderosis in an Adult. Thorax **11**: 101–104, June 1956.

SUMMARIO IN INTERLINGUA

Idiopathic Hemorrhagia Pulmonar Con Hemosiderosis E Anemia Microcytic

Es reportate le caso de un puera qui esseva sequite ab le etate de nove annos usque a su morte causate al etate de deceduo annos per idiopathic hemorrhagia pulmonar con hemosiderosis. Le curso clinic, le constatationes radiologic, e le observationes necroptic esseva characteristic.

Hemoptyse es un manifestation constante in iste morbo. In tanto que le condition progrede, il occurre tachypnea, dyspnea, pallor, tachycardia, basse grados de febre, leve grados de cyanosis, e finalmente jalnessa. Le roentgenogramma monstra densitates delicate de apparentia marmorisate in un distribution miliari o macular. Le tres criterios roentgenologic que ha essite describite es (1) multiple consolidationes primari que se clarifica intra un septimana plus o minus, (2) variabile configurationes de coalescentia, e (3) un subjacente configuration reticulostriate.

Iste diagnose debe esser prendite in consideration in omne patientes de juvene etate qui ha hemoptyse e qui exhibi un infiltration pulmonar de apparentia diffusemente marmorisate le qual varia, se clarifica, e recurre.

The Myelographic Examination of the Foramen Magnum[1]

LEONARD I. MALIS, M.D.

THE CLINICAL diagnosis of benign tumors in the region of the foramen magnum is often extremely difficult (2, 5, 8). Even if such a lesion is suspected, a satisfactory diagnosis may not be possible without roentgenologic evidence. In the presence of extradural malignant lesions, bone changes are generally detectable. The benign intradural tumors usually show no alterations on regular x-ray films, though a small proportion may exhibit thinning of one side of the arch of the atlas or ballooning of a cervical intervertebral foramen. Since these lesions may produce severe neurologic damage before complete spinal block appears, an accurate and safe method of confirming the diagnosis at an early stage has been a primary need. This appears to have been met by the development of the myelographic technic.

Myelographic examination of the foramen magnum presents some special difficulties as well as special requirements. In this region lesions are easily missed; yet even minor changes can be readily appreciated with adequate methods of myelographic study.

TECHNIC

The lumbar puncture and the instillation of oil are done in the usual manner, with the patient in the lateral recumbent position with the legs and back flexed, as shown in Figure 1, A. We prefer a short-beveled 18- or 19-gauge needle to the ordinary longer-beveled spinal needle; it is felt that the incidence of subdural or epidural injection is greatly reduced by the use of the short bevel and that the ease of oil removal is greater, since the needle opening can be brought nearer to the ventral surface of the canal during aspiration of the medium. A Queckenstedt test is usually performed at the time of the lumbar puncture. If an open system is demonstrated, an average of 12 c.c. of Pantopaque is used; if there is a complete block, the amount of oil is reduced 2 or 3 c.c. The cross-sectional areas of the cervical canal vary widely in different patients, as does also the fluid capacity (10). If, therefore, the routine injection of 12 c.c. appears inadequate after entering the cervical canal, a further 6 to 12 c.c. may be added. After the oil is introduced through the needle, the stilette is refitted and the patient is turned onto the abdomen, as in Figure 1, B.

The patient is instructed to attempt to hold the head in whatever position it is placed by the examiner and told that it will be flexed and extended at various times. An attempt is made to instruct him in flexion and extension of the neck as separate functions from flexion and extension of the head. He is specifically warned that under no circumstances is the head to be turned laterally and that the movements in the vertical position, namely, flexion and extension, are to be made only at the hands of the examiner and not otherwise. The oil is then brought up into the cervical region, the only problem in doing this being to get it across the dorsal hump without it entering the head. This can be managed in several ways by simple gravity. It is most usually done by holding the head in hyperextension with the table tilted head down so that the oil filling the cervical canal will at no time reach a level high enough to enter the foramen magnum as it pours over the dorsal hump to drop into the cervical region (Fig. 1, C). Normal patients do not have any blocking mechanism in the neck to stop the oil from going above this region. Here we have a pure U-tube type of protection. The level is simply not permitted to get higher in one arm

[1] From the Department of Neurosurgery, The Mount Sinai Hospital, New York, N. Y. Accepted for publication in August 1957.

of the U-tube than is desired in the other.

The average cervical canal of an adult will hold better than 24 c.c. when the head and neck are held hyperextended, without any Pantopaque going into the foramen magnum, while the table is tilted down at 50°. If only 12 c.c. are used, the hyperextension does not need to be so extreme, and it is relatively simple to pour the oil over the dorsal hump. With the average patient, the table is tilted head downward slowly until the oil starts to trickle over the hump. The minimum amount of tilt is used which will allow the cervical region to fill with oil and will permit all of the lumbar oil to pour over the dorsal hump. This can be made easier by placing a pillow beneath the patient's hips, as shown in Figure 1, D. By this means it is possible to pour oil into the cervical region with only 20 to 30° of tilt and minimal hyperextension of the head. Once the oil has entered the cervical canal, the table is returned to the horizontal position and tilts are thereafter limited to 15 or 20° in either direction, depending upon the manipulative needs.

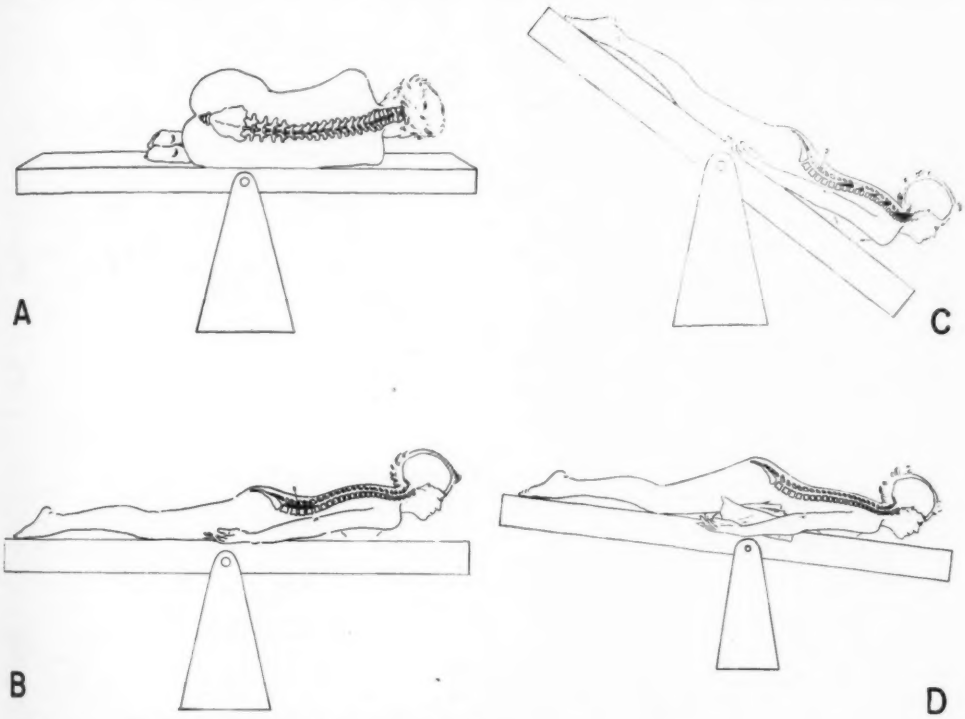


Fig. 1. A. The patient in position for the spinal puncture.
B. After the instillation of the oil the patient is turned on the abdomen.
C. By downward tilt of the table and hyperextension of the head, the oil is permitted to run into the cervical canal without entering the cranial cavity.
D. The use of a pillow beneath the hips permits the oil to be poured into the cervical canal with less downward tilt of the table. Less hyperextension is required to prevent the oil from entering the head.

The use of a lateral fluoroscope which will allow one to view across gravity while controlling the oil in the vertically positioned U tube of the cervical spine is of great advantage. Although most of our work has been done without this aid, its use in some of our more recent procedures has afforded confirmation of many of the ideas and considerations which developed in the formative period of this work. If a true biplane machine were available, it would seem advantageous to do virtually

all of the cervical region fluoroscopy in the lateral projection. It appears to be much the more important aspect, and the entire procedure is easier when controlled in this manner. This equipment, however, is not readily available in most hospitals and accordingly most of our discussion will be confined to the use of the ordinary fluoroscopic table with the addition of cross-table lateral films taken on a grid cassette.

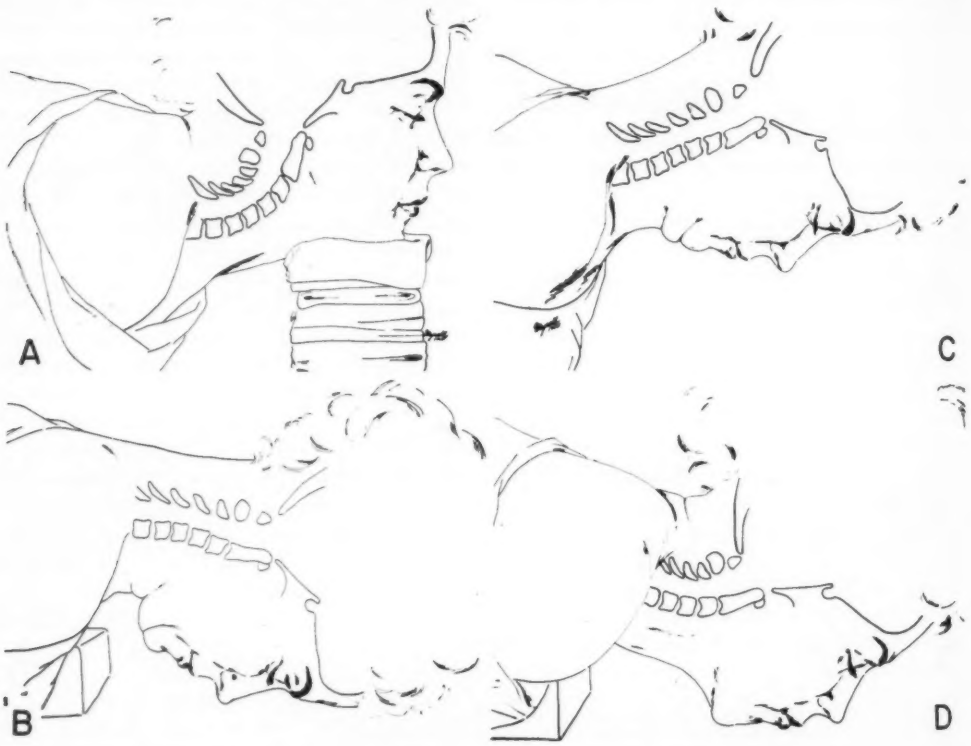


Fig. 2. A. The neck is extended upon the shoulders, and the head is extended upon the neck.
B. The neck is flexed upon the shoulders and the head is flexed upon the neck.
C. The neck is extended upon the shoulders and the head is flexed upon the neck.
D. The neck is flexed upon the shoulders and the head is extended upon the neck.

The method of holding the patient to the table has varied considerably. Our present equipment consists of a shoulder brace in which 2 padded steel shoulder blocks are fastened near the head of the table so that the shoulders rest against them. When shoulder blocks of this type are used, the patient must be so positioned that the upper travel of the fluoroscopic screen is sufficient to pass the top of the head. Since most fluoroscope screens cannot be used close to the ends of the table, it is necessary that the patient be positioned well back from the end. He is then held to the table by two compression bands, one about the shoulders and the other across the buttocks, so that he may be inverted vertically, if necessary. As an alternative to the shoulder blocks and compression bands, a sling of canvas is available, passing from the foot of the table, where it is attached to the foot plate, up and around the shoulders of the patient and back again to the foot plate. This sling is in many ways a convenient device; a disadvantage lies in the fact that no fluoroscopic table is really quite long enough to permit the patient, unless he is very short, to

be positioned in this way without the knees being bent so that he is actually unable to straighten out his legs against the foot plate, which is relatively uncomfortable. Since most of our actual fluoroscopic study and film taking is done with the patient either level or tilted not more than 10 or 15 degrees in either direction, either to flex or extend the head. The two movements are related but not necessarily required to complement each other, so that the head may be extended on the neck, while the neck is flexed upon the shoulders. If now the head and neck be flexed together, as in Figure 2, B, with the patient in the flat position, and the oil in the cervical

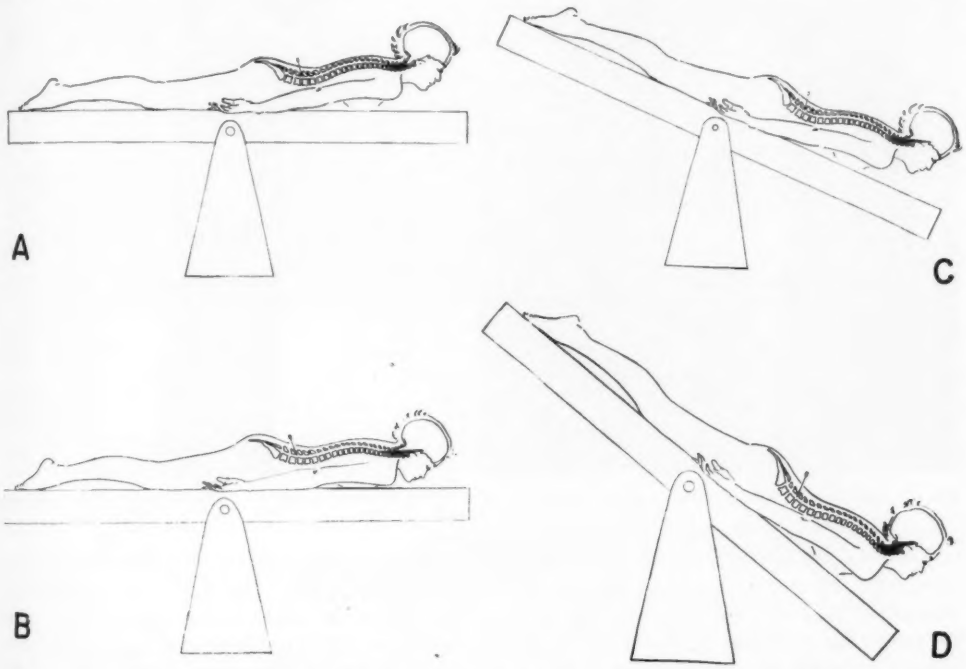


Fig. 3. A. After the oil has been brought into the cervical region, the table is returned to the horizontal.
B. By manipulation of the head and neck with the table horizontal, the oil can be brought up onto the clivus.
C. Somewhat better filling of the posterior portion of the cervical canal with less flexion of the neck and a greater table tilt.
D. Filling of the dorsal portion of the foramen magnum with extension of head on the neck and neck on the shoulders and marked downward tilt of the table.

it seems preferable to start with the shoulder brackets. These are used only for the initial part of the study and are then removed, allowing the patient to be free upon the table, which is in an almost horizontal position for the remainder of the examination.

At this point it is necessary to digress a bit for discussion of flexion of head and flexion of neck as separate entities. As demonstrated in Figure 2, it is possible to extend or flex the cervical spine upon the shoulders separately and at the same time, spine, a point will be reached in which the foramen magnum will be sufficiently low to allow oil to run in along the clivus. Since the clivus at this point will be pointing rather sharply downward, the oil will run forward, pour over the posterior clinoids, and disperse in the anterior and middle fossa. If, on the other hand, the head is maintained in some extension and the neck is brought forward into flexion, as in Figure 2, D, it is possible to lower the foramen magnum below the level at which the oil will run into it and at the same time

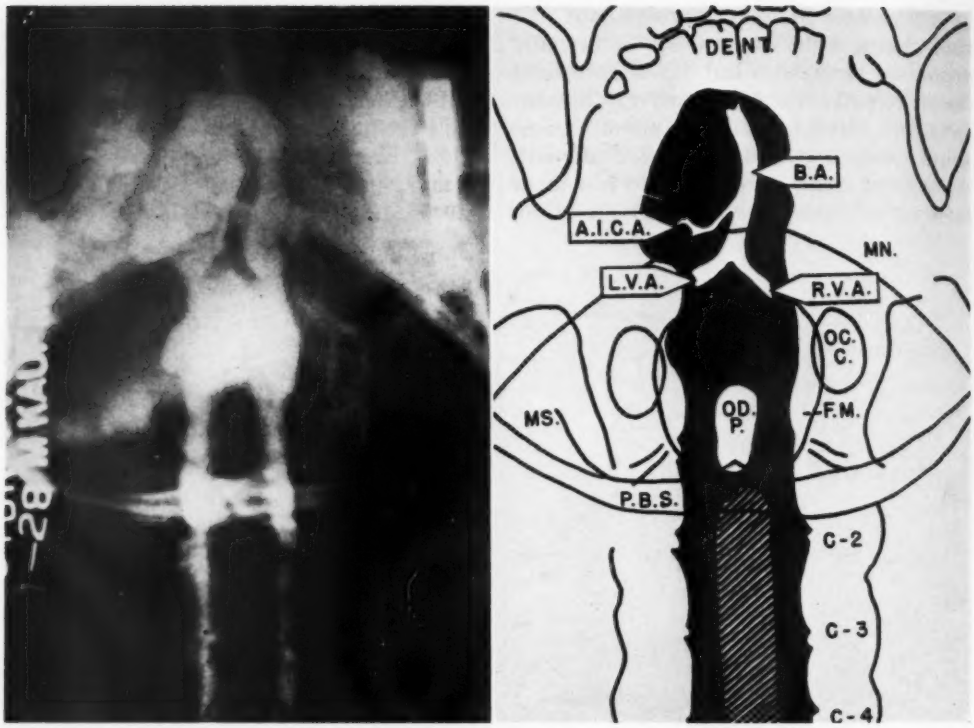


Fig. 4. Normal anteroposterior view of foramen magnum and clivus myelogram. For key to abbreviations, see p. 202.

to keep the angle of the clivus tilted slightly upward from the foramen to the posterior clinoid so that oil entering this region can be maintained in the gutter of the clivus (Figs. 3A and B), where it can be controlled, examined, and recovered. In many patients it is not possible to flex the neck downward far enough to satisfy these conditions, since the chin will strike the table. In this event a pad or pillow can be placed beneath the upper chest to allow more room to drop the head downward, to produce the desired result. If, under these conditions, the oil is run past the foramen magnum, it can be balanced right up along the clivus. With a little experience, one can determine the proper angles of tilt and flexion and control the oil with reasonable ease with the usual fluoroscope table. With a biplane fluoroscope, the skill required to carry out this procedure is very much reduced and exactly what is happening becomes obvious on the first attempt.

Lateral films are taken after filling of the clivus has been visualized fluoroscopically in the anteroposterior projection and appropriate anteroposterior spot films have been taken. The lateral views are obtained by positioning the tube lateral to the patient and shooting across the table to a grid cassette, so that the film is taken with a horizontal beam.

Filling of this region, with even better filling of the dorsal portion of the foramen magnum, can also be achieved with the head and neck both extended and the table tilted downward 30 to 45°, as shown in Figure 3, D. The lateral fluoroscope is necessary for any degree of control, however, and larger quantities of Pantopaque are usually required. It is generally necessary to add oil until the fluid levels reach the required area. This may take up to 30 c.c. This technic is much more uncomfortable for the patient, because of the head-down position and marked extension

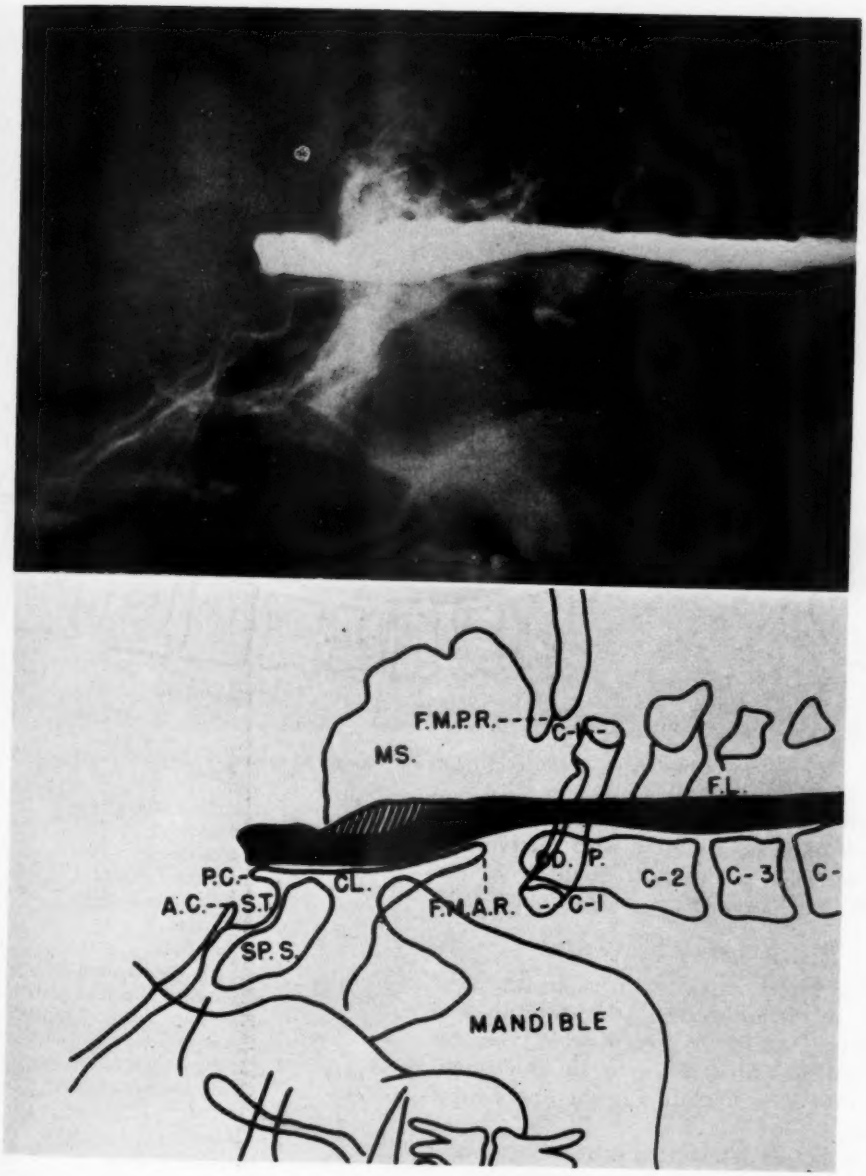


Fig. 5. Same case as Fig. 4. Normal cross-table lateral view.

necessary, and for these reasons has rarely been utilized.

We have preferred to maintain the head in the true anteroposterior position and do not permit or utilize lateral rotation. While the border of the foramen magnum can be readily filled by rotating the head into the oblique position, it has been our feeling that if the oil is carried further into the posterior fossa in this position, and is allowed to pour laterally into the cerebellopontine angle, its recovery is unlikely. While it is not felt that the loss of the oil is of any importance in the production of

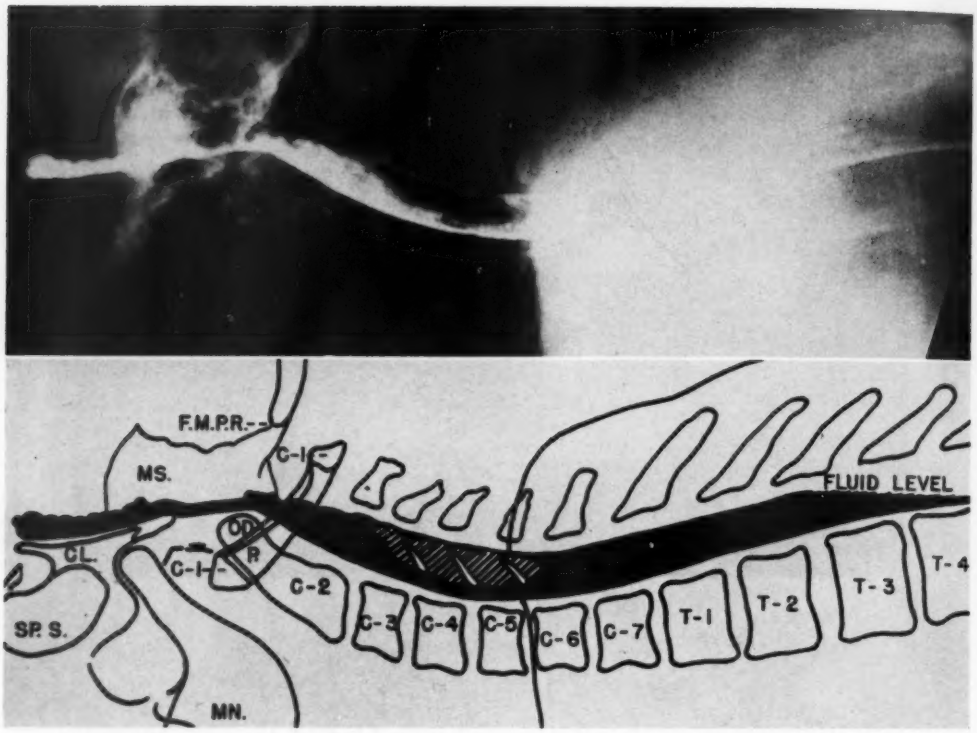


Fig. 6. Normal cross-table lateral view demonstrating the concept of the cervical spinal canal as a "U" tube.

symptoms, one may be unable to complete an adequate examination with the remaining oil when a sufficient quantity of the medium has been lost from control.

ILLUSTRATIVE CASES

Illustrative cases are perhaps the best way of demonstrating the technic and findings. With the exception of the last patient presented (Fig. 26), no abnormalities were seen on plain films in any of these cases.

For better delineation of the anatomical relationships, line drawings have been constructed to parallel each film. These drawings have been controlled by projection technic in an effort to make them as accurate as possible. The following is a key to the abbreviations used in the figures:

A.C.M. . . . . Arnold-Chiari malformation
A.S.A. . . . . anterior spinal artery
OD.P. . . . . odontoid process
C-1. . . . . arch of atlas
F.L. . . . . fluid level
S.T. . . . . sella turcica
P.C. . . . . posterior clinoid
A.C. . . . . anterior clinoid
MS. . . . . mastoids
MN. . . . . mandible
F.M. . . . . foramen magnum
F.M.P.R. . . . . foramen magnum posterior rim
F.M.A.R. . . . . foramen magnum anterior rim
B.A. . . . . basilar artery
R.V.A. . . . . right vertebral artery
L.V.A. . . . . left vertebral artery
CL. . . . . clivus
MX. . . . . maxilla
SP. S. . . . . sphenoid sinus
P.I.C.A. . . . . posterior inferior cerebellar artery
A.I.C.A. . . . . anterior inferior cerebellar artery
N.C. . . . . nasal choanae
Dent. . . . . dental prosthesis or teeth
P.B.S. . . . . posterior base of skull
MX. S. . . . . maxillary sinus

In Figure 4, the spot-film from the fluoroscopic screen taken in the anteroposterior position shows a typical normal appearance with 12 c.c. of Pantopaque

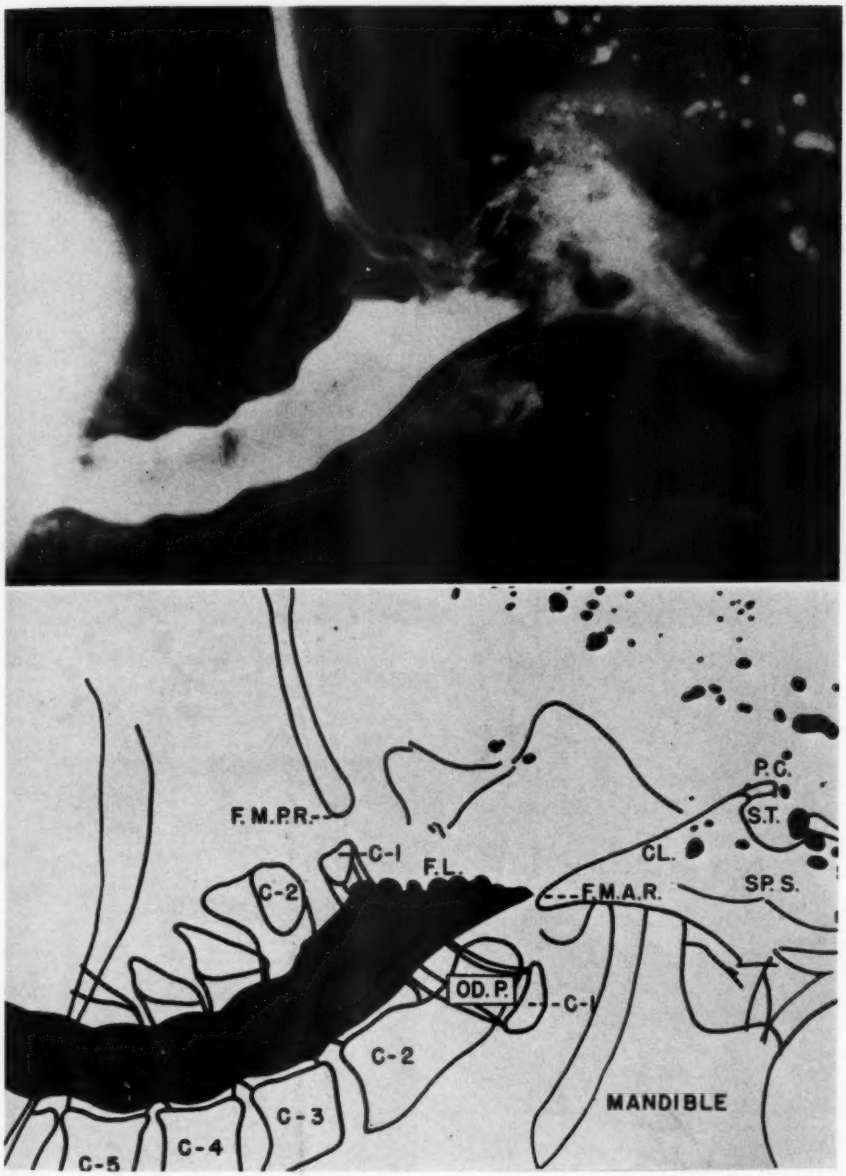


Fig. 7. Normal cross-table lateral myelogram with larger quantities of oil.

collected in the cervical canal and up the gutter of the clivus as far as the posterior clinoids. The patient has been placed with the neck flexed forward on the shoulders and the head very slightly extended on the neck. The odontoid process is outlined as a defect in the oil film in the foramen magnum. There is a characteristic incomplete filling of the midportion of the cervical canal representing the spinal cord. The vertebral and basilar arteries are outlined and are normal in position and configuration.

Figure 5 is the lateral view of the same

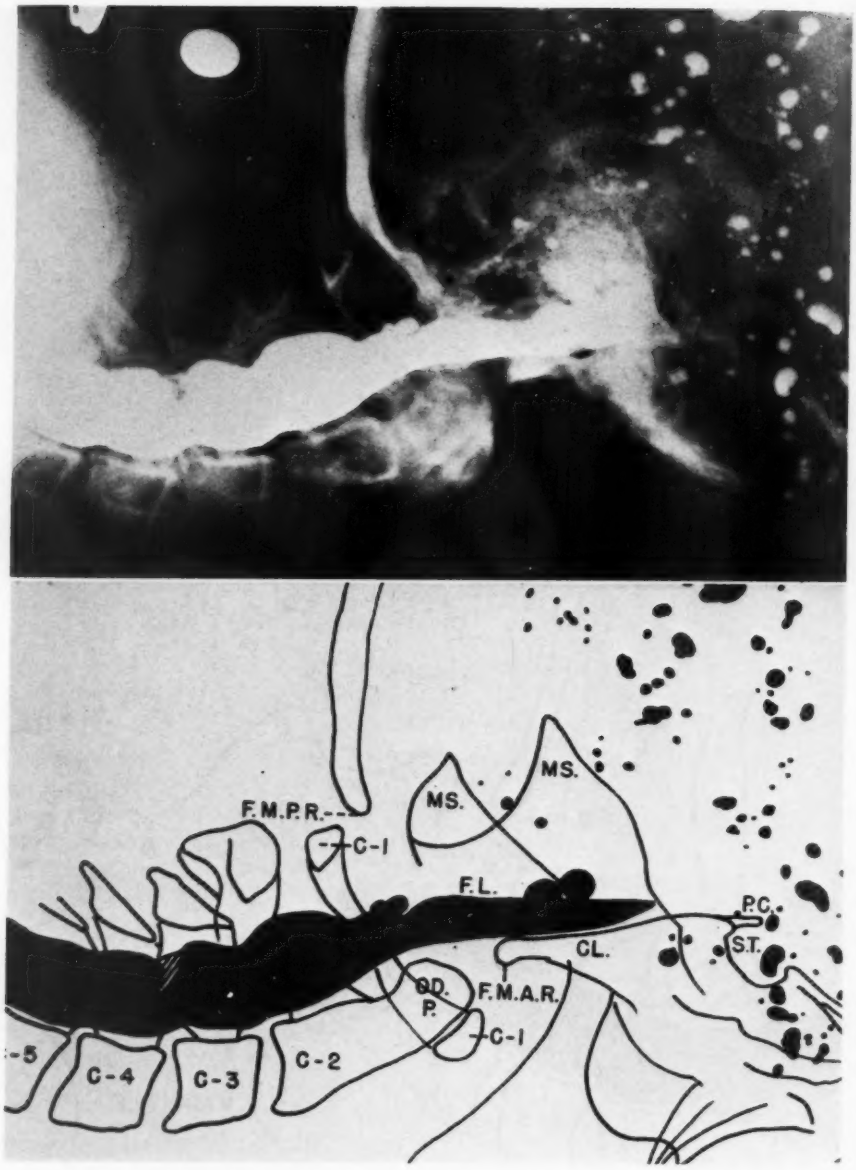


Fig. 8. Same case as Fig. 7. Lateral view showing the result of additional flexion.

patient taken with a horizontal beam, a grid cassette, and a laterally placed x-ray tube. This is commonly referred to as a cross-table view. It was taken without altering the patient's position appreciably except that the head was slightly more flexed. The fluid level along the upper margin of the Pantopaque column shows the true horizontal. In this position the oil can all be returned from the clivus by elevating the patient's head. The shaded area in the drawing represents the partial lucency in the oil column produced by the pons. It is obvious that in this position

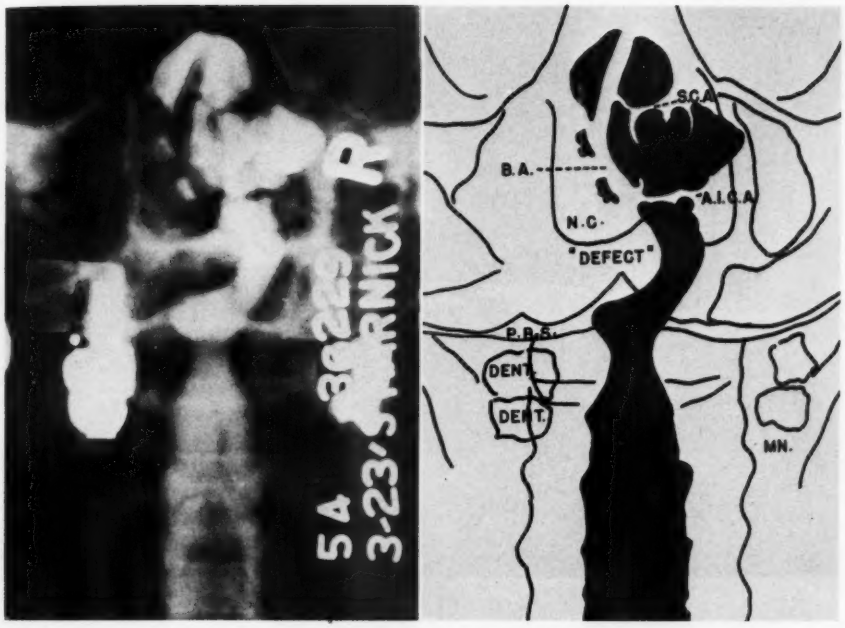


Fig. 9. Anteroposterior myelographic view with failure of the oil to cross to the left of the basilar and left vertebral artery.

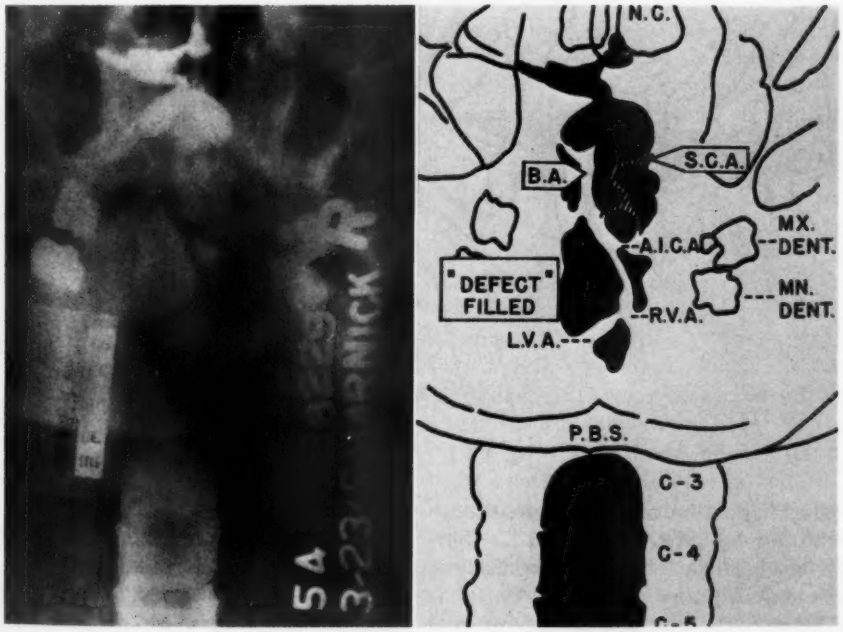


Fig. 10 Same case as Fig. 9. Filling of the clivus area to the left of the basilar artery has now been achieved.

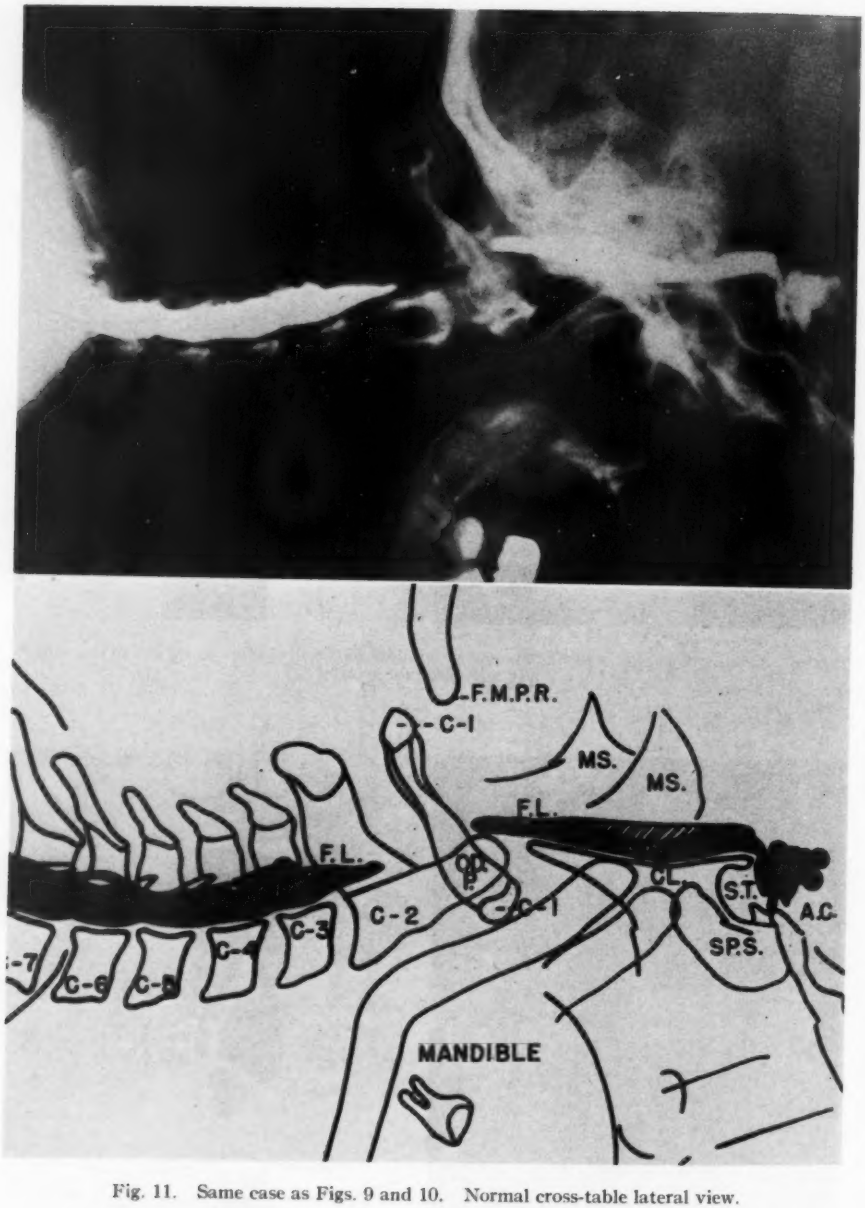


Fig. 11. Same case as Figs. 9 and 10. Normal cross-table lateral view.

the posterior portion of the foramen magnum cannot be adequately filled. This amount of visualization may, nevertheless, be sufficient in many cases.

In Figure 6 the concept of the cervical canal as a U tube can be demonstrated, wherein a slightly larger amount of oil (18 c.c.) has been used. There is a fluid level at the lower margin of the oil, extending from T-2 to T-4, and at the top of the column at the foramen magnum, where a little oil has been allowed to run down the clivus. The lucency in the mid-portion of the cervical canal is again normal and repre-

sents the displacement of the Pantopaque by the spinal cord and its roots.

Another normal case is shown in Figure 7, again in the cross-table lateral view. A previous myelographic study had been done elsewhere, with an attempt to fill the foramen magnum with the aid of oblique positioning. The filling had not been considered satisfactory for diagnostic purposes, but a great deal of the oil had been lost into the cranial cavity, where it was now obvious as multiple globules of Pantopaque in the subarachnoid space. The present myelogram was obtained with 18 c.c. of oil, and a fluid level can be seen extending from the posterior arch of the atlas to the anterior rim of the foramen magnum. By the addition of another 3 to 6 c.c. of Pantopaque, it would have been possible to raise this fluid level 1 or 2 cm. and so to fill completely the posterior portion of the foramen magnum. It would have also been possible, theoretically, to raise the fluid level to the same degree by flexing the patient's neck upon the thorax while maintaining the angle of the head fixed with reference to the horizontal, but this maneuver was not possible because of the patient's severe spasticity. As the head was brought forward by flexing the neck on the thorax, it was necessary, therefore, to permit some further flexion of the head upon the neck (Fig. 8). This permitted the oil to come up along the clivus, and the films are considered completely normal. It was felt that, while additional Pantopaque could complete the filling, the diagnostic information was adequate.

Figure 9 is an anteroposterior view, with the column reaching to the posterior clinoids but with a defect unfilled on the left side just above the foramen magnum. Before this defect is considered, the region of the odontoid should be noted. There is here a constricted column with a waist-like narrowing. This is one of the two normal variants of this region and depends upon the relative prominence of the odontoid process. In some patients where the odontoid is not prominent, the region over this process may be the deepest portion of the dural sac. The Pantopaque will run down into the center of the canal at this point, leaving the waist-like filling with the lateral portions of the canal unfilled. In the other type of normal variant the odontoid process is prominent and shows a central defect in the canal with the oil filling more widely in the lateral portions of the canal of this region. This was illustrated in Figure 4.

To return to the apparent defect in filling the left side of the clivus; when repeated attempts at repositioning the oil failed to fill this region, it was thought that a posterior fossa mass might have been demonstrated. The smooth continuation of the oil curve, however, suggested the probability that one of the vertebral arteries was responsible for the failure to get the oil across. The patient was placed with the head in moderate extension, and the table tilted sharply downward so that more oil was brought up onto the clivus; after a small amount of oil had begun to run forward past the posterior clinoids, the horizontal position was resumed. This situation is shown in Figure 10, where the apparent defect of the previous picture has now been filled. The basilar and vertebral arteries have been outlined by the oil film, demonstrating that the apparent defect was in fact attributable to inability to get the medium past these arteries. This may have been in part due to subarachnoid septa connecting the arteries to the arachnoid. At the upper part of the oil shadow, the small amount of oil which passed the posterior clinoid can be seen extending forward in the midline toward the tuberculum sellae and laterally into the beginning of the sylvian fissure. This study was also considered to be normal.

In Figure 11, a cross-table lateral view of the case shown in Figure 10, oil has been brought up onto the clivus, while some has been allowed to trickle forward past the posterior clinoid, where it is spreading out as an irregular "glob" near the anterior clinoids and sella turcica. This oil which has passed the posterior clinoids is not likely to be recovered. The head then has

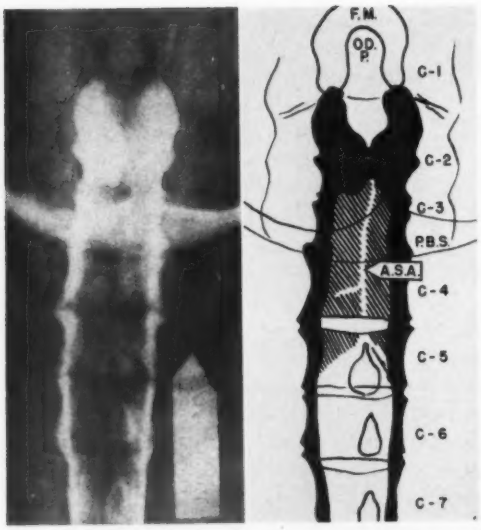


Fig. 12. Apparently normal anteroposterior myelogram, demonstrating the inconclusiveness of a study which does not extend high enough to visualize the vertebral arteries

been re-elevated, thereby balancing the remaining oil on the clivus and allowing the oil in the cervical canal to drop downward, producing a gap in the oil column extending from the top of the odontoid process down to the middle of the body of C-2. There is a fluid level at the top of the cervical oil column extending from C-3 to C-2, and it is worth noting that this level makes an acute angle with the advancing edge of the oil column opposite the middle of the body of C-2. This pointed shadow is, of course, the typical normal appearance of the across-gravity view of the upper limit of a fluid level in the cervical canal and will have to be distinguished from the appearance produced by an obstructing lesion.

In Figure 12 oil is shown filling the cervical canal to the base of the odontoid process, where it is widening out to fill the lateral gutters, apparently because of the prominence of the odontoid process. This degree of filling, stopping short of the foramen magnum, by no means excludes a lesion of this region, as is demonstrated in Figure 13 (same patient). The head has now been brought forward and the oil has

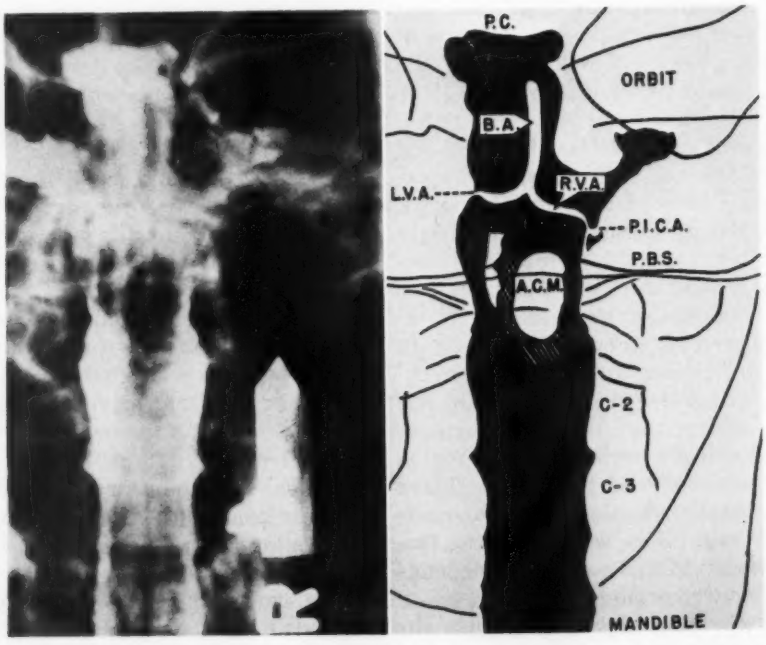


Fig. 13. Same case as Fig. 12. Adequately high filling shows the tonsillar and medullary displacement of the Arnold-Chiari malformation.

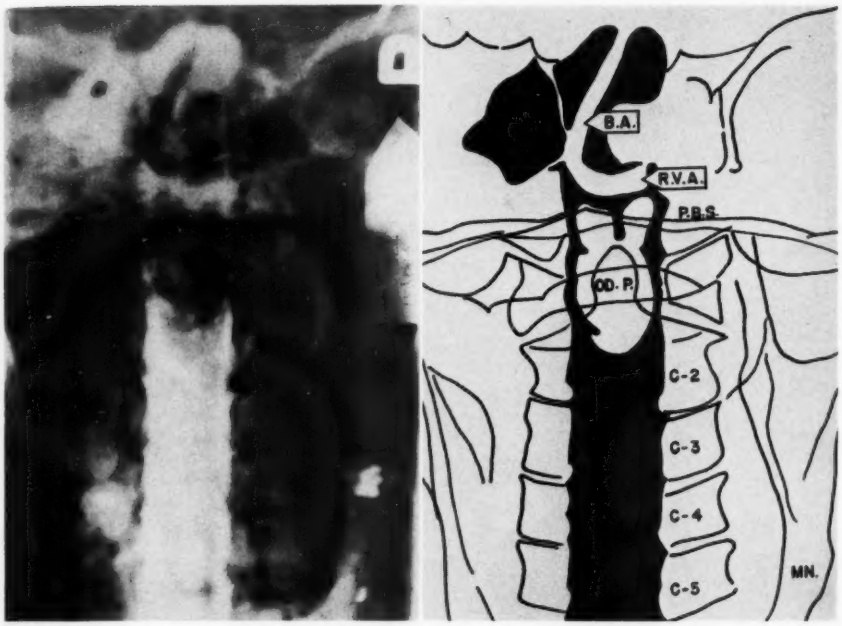


Fig. 14. Anteroposterior myelographic view of another Arnold-Chiari malformation.

been carried up to fill the clivus, demonstrating a characteristic defect at the foramen magnum, representing an Arnold-Chiari malformation (6). Above this malformation the vertebral and basilar arteries are seen.

Another illustration of an Arnold-Chiari malformation is shown in Figure 14, where the herniated cerebellar tonsils and medulla produce a marked defect extending from below the odontoid process up through the foramen magnum, with very little oil filling in this area, although sufficient oil was able to get past the lesion to outline the right vertebral and basilar arteries. The obliquity and position of the vertebral and basilar artery in this patient are well within the normal variability of these vessels as demonstrated by myelographic visualization of the clivus region.

In Figure 15, the myelogram, performed in June 1950, shows the type of filling which at one time had been considered adequate for cervical myelography, with the oil column ending just below the base of the odontoid process. This patient had had previous myelographic study of the cervical region only a few weeks earlier, at another institution, and been reported to be normal on the basis of filling to a degree almost identical with that shown in this figure. The head is in marked hyperextension and, since in this position one is looking down the cervical canal through the foramen magnum, the foreshortening of the canal may make the oil level appear to be reaching a much higher position than is actually the case. As this patient's neck was brought down in flexion, as shown in Figure 16, an almost complete block was encountered at the level of the arch of the atlas, and only a very small amount of Pantopaque was able to pass upward on the clivus. This block was verified surgically as a large meningioma, and an excellent operative result was obtained.

In Figure 17, a normal appearing filling of the cervical canal extending up to C-2 is demonstrated, with a defect in the middle of the cervical canal due to the normal displacement of the Pantopaque film by the cervical cord. In this view the patient's

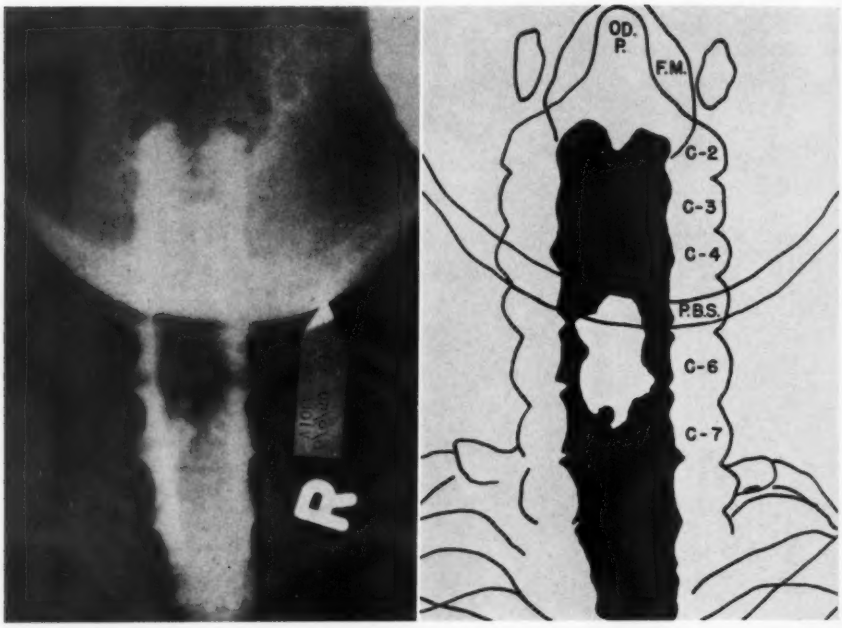


Fig. 15. Apparently normal anteroposterior myelogram. The oil has not been carried high enough to demonstrate the vertebral arteries.

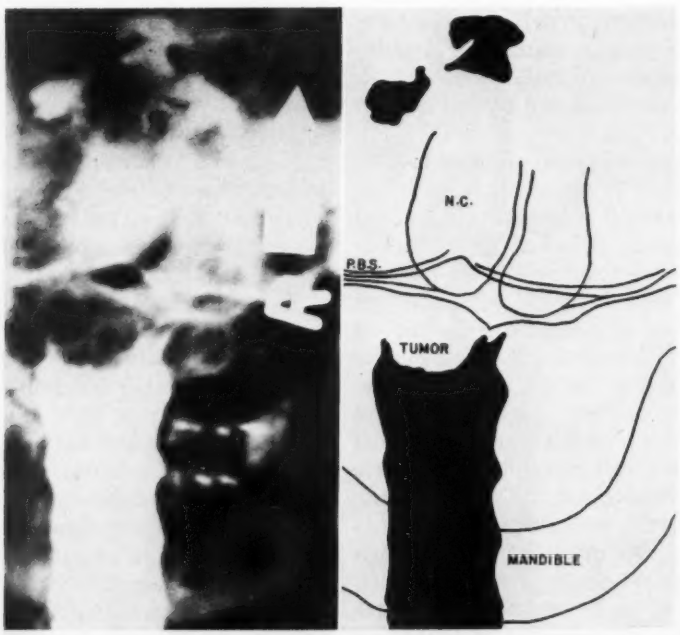


Fig. 16. Same case as Fig. 15. Foramen magnum meningioma has produced a virtually complete block, demonstrated by flexing the head and neck from the position used in Fig. 15.

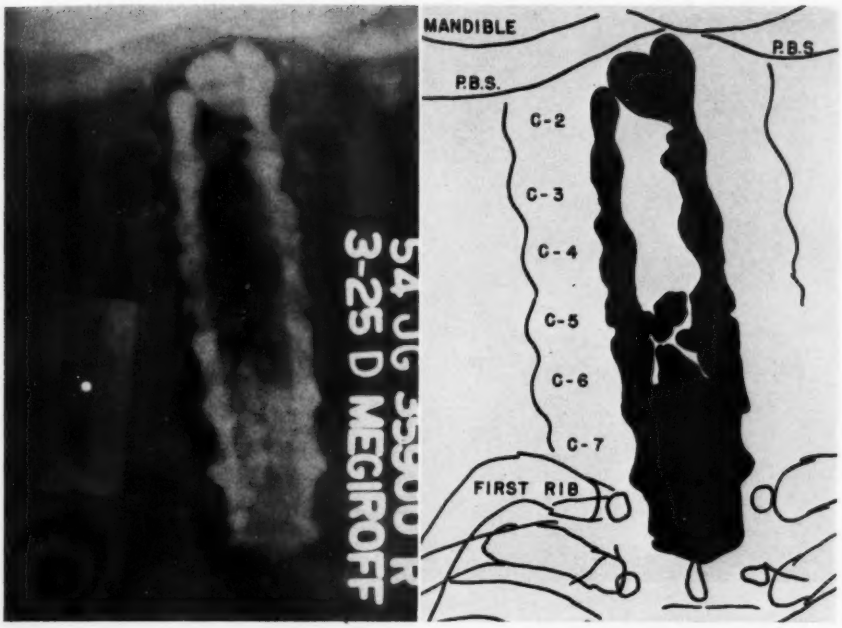


Fig. 17. Apparently normal anteroposterior myelogram. The oil has not been carried high enough to demonstrate the vertebral arteries.

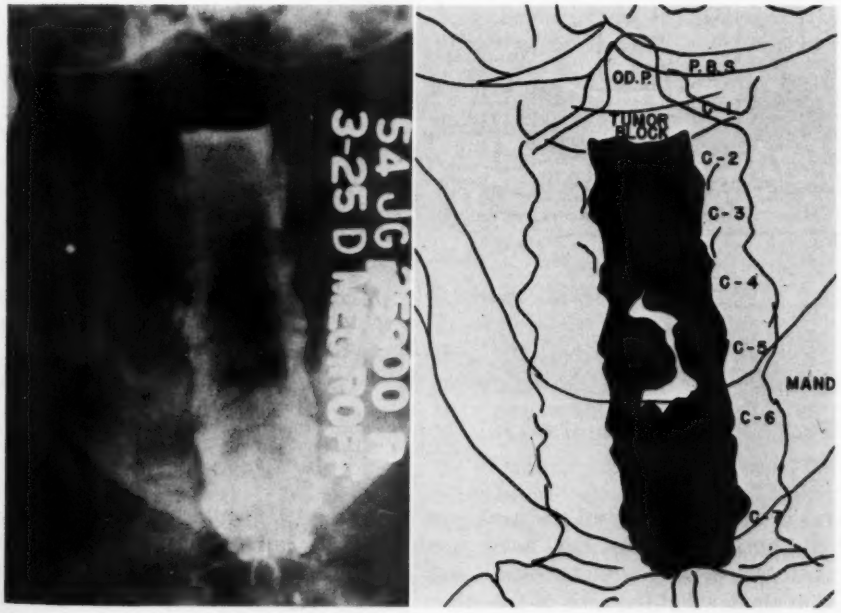


Fig. 18. Same case as Fig. 17. The head and neck have been flexed, and a completely blocking meningioma at C-1 is demonstrated.

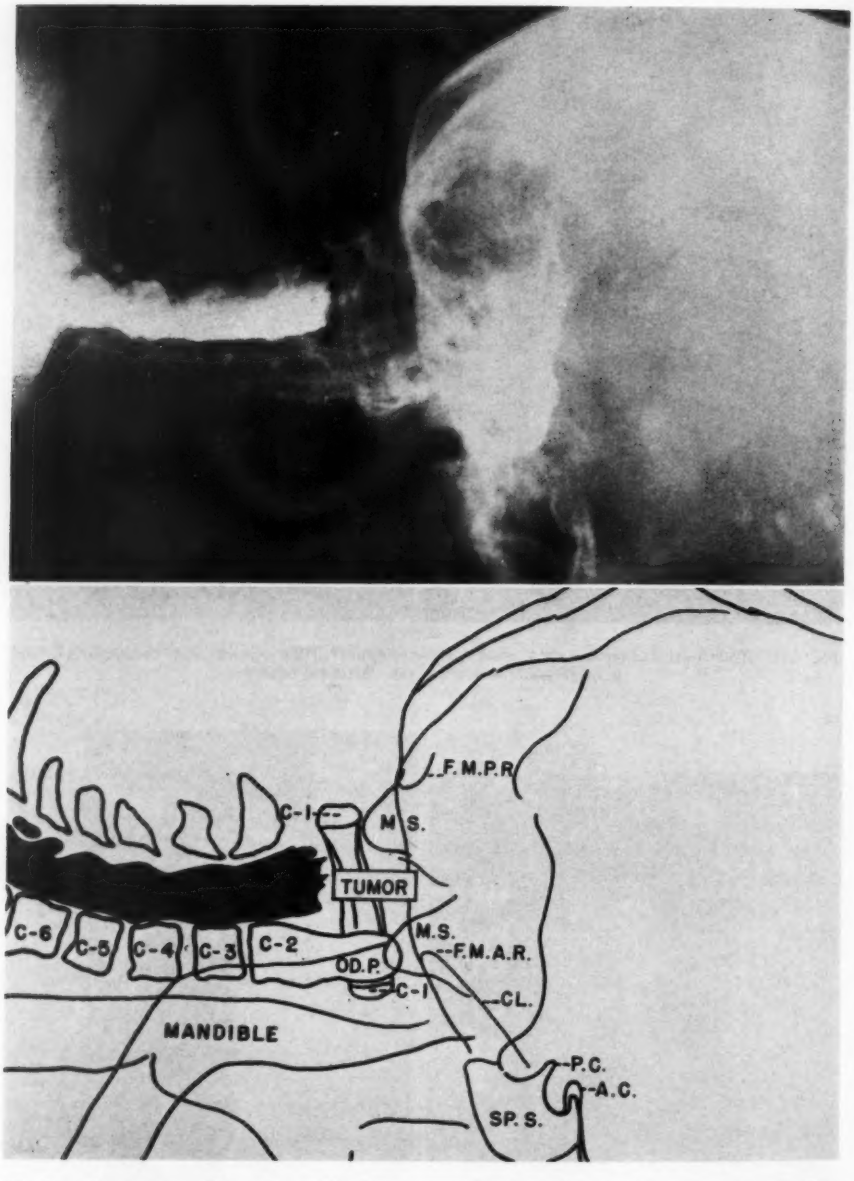


Fig. 19. Same case as Figs. 17 and 18. The cross-table lateral projection shows the complete block at C-1.

head was in mid-position and the neck was relatively horizontal. As the head was brought forward, a complete block was reached at the level of the arch of the atlas, as shown in Figure 18. The cross-table lateral view in the same patient is shown in Figure 19, where the head had been brought into complete flexion, with the clivus angling sharply downward, since the complete block prevented any oil from entering the foramen magnum. A ventral meningioma of the foramen magnum

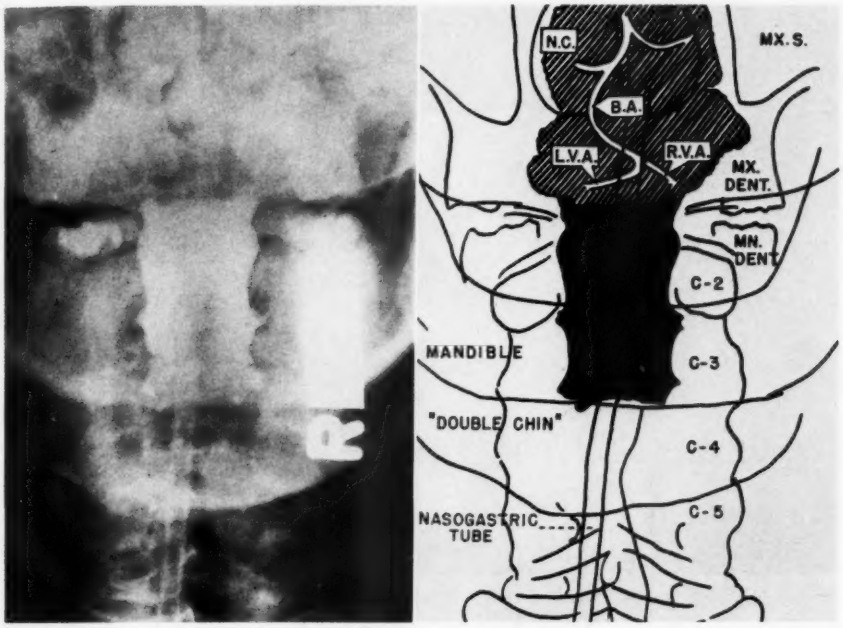


Fig. 20. An incomplete block in the anteroposterior view, produced by a large foramen magnum meningioma.

was removed surgically and the patient made an excellent recovery.

Figure 20 demonstrates the appearance of one of the very early cases (1950), with an incomplete block at the foramen magnum, the film of oil passing along the clivus and being allowed to pour forward into the subarachnoid space of the frontal fossa. In the lateral view (Fig. 21), it can be seen that there is a fluid level extending from the body of the third cervical vertebra up to almost the posterior rim of the foramen magnum, and that the foramen magnum there is a vertical, slightly concave cut-off to the Pantopaque column, with a trickling of the Pantopaque by the periphery of the block. Since the clivus is pointing almost 60° downward, any Pantopaque which gets past the block rapidly disperses into the head. The large triangular shadow of the Pantopaque in the upper cervical canal is, of course, a characteristic appearance produced when a lesion blocks the flow of oil. It should be compared with Figure 11, where the apex of the triangle points toward the foramen magnum and is a perfectly normal upper limit to the oil flow. Any defect seen beneath a fluid level, on the other hand, must be significant, and our general approach to myelographic diagnosis depends upon the demonstration of incomplete filling below a fluid level as the criterion for the genuineness of the lesion. This lesion was a meningioma, verified postmortem, no operation having been permitted.

In Figure 22 the oil has just been allowed to enter the foramen magnum with the head moderately extended but with the table tilted downward almost 30°. Above the odontoid process, is a defect whose shape, size, and exact relationship to the visualized odontoid differentiate it from the normal odontoid, and are diagnostic of tumor. In the same case, the cross-table lateral view (Fig. 23) demonstrates a later stage in the procedure, when the head had been allowed to come into more flexion and most of the Pantopaque had been allowed to go on to the clivus. There is a triangular shadow with a fluid level at its upper border overlying the laminae of C-2

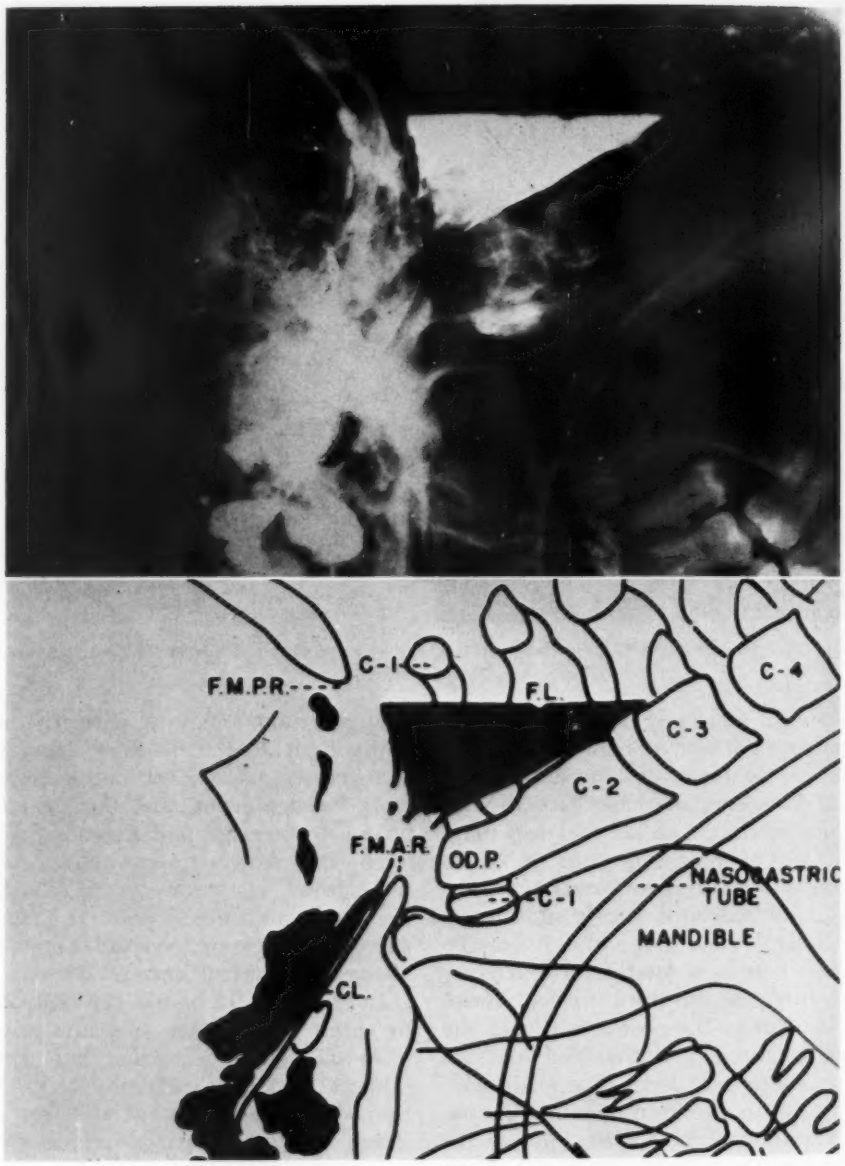


Fig. 21. Same case as Fig. 20. Cross-table lateral view, showing partial block with fluid level. Oil is pouring over the clivus because of the marked flexion of the head.

with the apex of the triangle reaching almost to the lower edge of the body of that vertebra. The border of the triangle which faces the arch of the atlas represents cutting off of the column below the fluid level and accordingly is diagnostic of a blocking lesion at the arch of the atlas. This small triangular shadow has the same diagnostic significance, as the very much larger shadow in Figure 21. A ventral meningioma was removed at operation, with complete recovery.

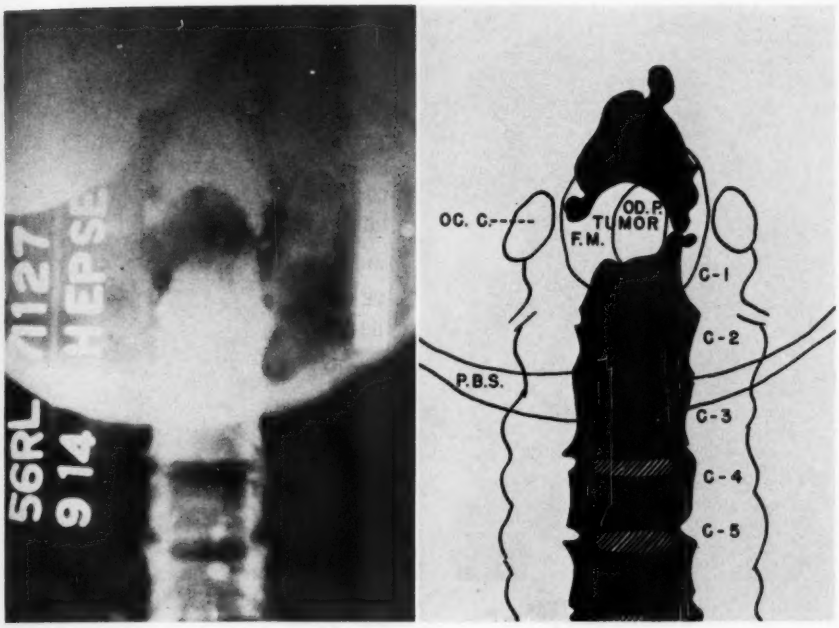


Fig. 22. Anteroposterior view showing meningioma arising from the left side at C-1.

In Figure 24, a fairly round tumor extending from an attachment at the right side between C-1 and C-2 allows the Pantopaque to flow around to the left and enter the foramen magnum, partly concealed beneath the patient's dental bridge work, then separate around the defect produced by the odontoid head, and outline the vertebral and basilar arteries, which are well within the limits of normal variability. In the cross-table lateral view of the same patient (Fig. 25), there is a concave defect at the upper edge of the major oil column of the cervical canal ending at the lower portion of the body of C-2. This shadow could by itself be debatable because only a slight concavity in upward angulation distinguishes it from the simple advancing edge of the fluid level, while in actuality it represents the ventral and inferior border of a round tumor. On the other hand, just posterior to the odontoid process there is visualized a small triangular opacity which has a fluid level as its upper border and the dura covering the odontoid as its ventral border, and for its caudal border shows a cut-off facing toward the lamina of C-2. There is a caudal extension of partial opacity which represents a small portion of the oil film passing laterally to go around the tumor. This small triangle by itself would be diagnostic of a partly obstructing lesion below it in the cervical canal. When the several shadows are visualized together, however, there can be no question of the fact that they outline a round tumor at the C-2 level. A meningioma was removed at operation with complete relief of symptoms.

Figure 26 illustrates a case in which there were obvious abnormalities in the plain films. This patient had a subluxation of the atlas on the axis, of fairly severe degree. Since the articulation of the base of the skull is with the atlas, it might be considered that the patient had a dislocation of the head and first cervical vertebra as a unit on the rest of the cervical spine. At myelography an incompletely blocking defect was encountered at the arch of the atlas. This defect is due to the fact that the posterior rim of the foramen

Fig. 23. Same case as Fig. 22. Cross-table lateral view demonstrating the fluid level on the small amount of oil that had not been allowed to run past the tumor.

magnum and the arch of the atlas have moved forward toward the odontoid process, so constricting the available space and compressing the spinal cord that there is no room for any appreciable amount of Pantopaque at this level.

DISCUSSION

The first theoretical objection to a myelographic study of this area was based upon the possible danger of Pantopaque entering the cranial cavity.

A number of patients had been available

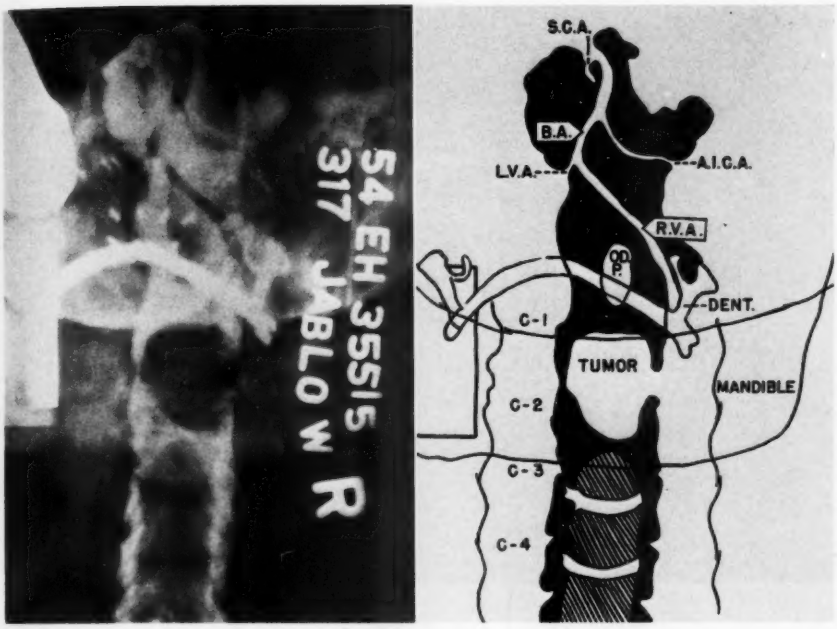


Fig. 24. Anteroposterior view showing meningioma arising from left ventral aspect of the canal at C-2.

for study, in whom, for one reason or another, varied quantities of Pantopaque had been permitted to remain in the lumbar canal. These patients had then gone about their normal activities. Later skull films had frequently demonstrated an appreciable amount of the medium scattered in the subarachnoid pathways along the base of the skull and over the cerebral hemispheres, and occasionally, to a much lesser extent, in the ventricles, and this without any apparent symptomatology. A review of many of these cases seemed to indicate that there was no danger worth contemplating in the idea of allowing Pantopaque to become intracranial and that this should not be a deterrent to the procedure. Other investigators had used Pantopaque as an intraventricular contrast medium for demonstration of lesions of the fourth ventricle and aqueduct area, with little difficulty (1, 4), though in relatively small quantities. Nevertheless, in the early stages of setting up the technic, utmost caution was used to prevent spillage of oil intracranially.[7] The present procedure permits the examination of the cervical spine, including the foramen magnum, the base of the skull including the clivus up to the posterior clinoids, and the ventral surface of the pons, with the complete return of all Pantopaque into the lumbar region for removal. If oil is inadvertently or deliberately allowed to go further than the posterior clinoids and to spill into the middle or anterior fossa by further flexion, or by lateral movements of the head, this portion of the oil is generally lost and cannot be returned to the lumbar region with any degree of adequacy or consistency. It has now, on the basis of a considerable number of such patients, become obvious that, aside from a possible slight increase in headache of a few days or a few hours duration, there are no significant symptoms referable to this dispersion of Pantopaque.

Considering the amount and frequency of use of Pantopaque, it is remarkable that so few cases have been reported as showing sequelae. Erickson and Van Baaren's case (3) of fatal meningoencephalitis, oc-

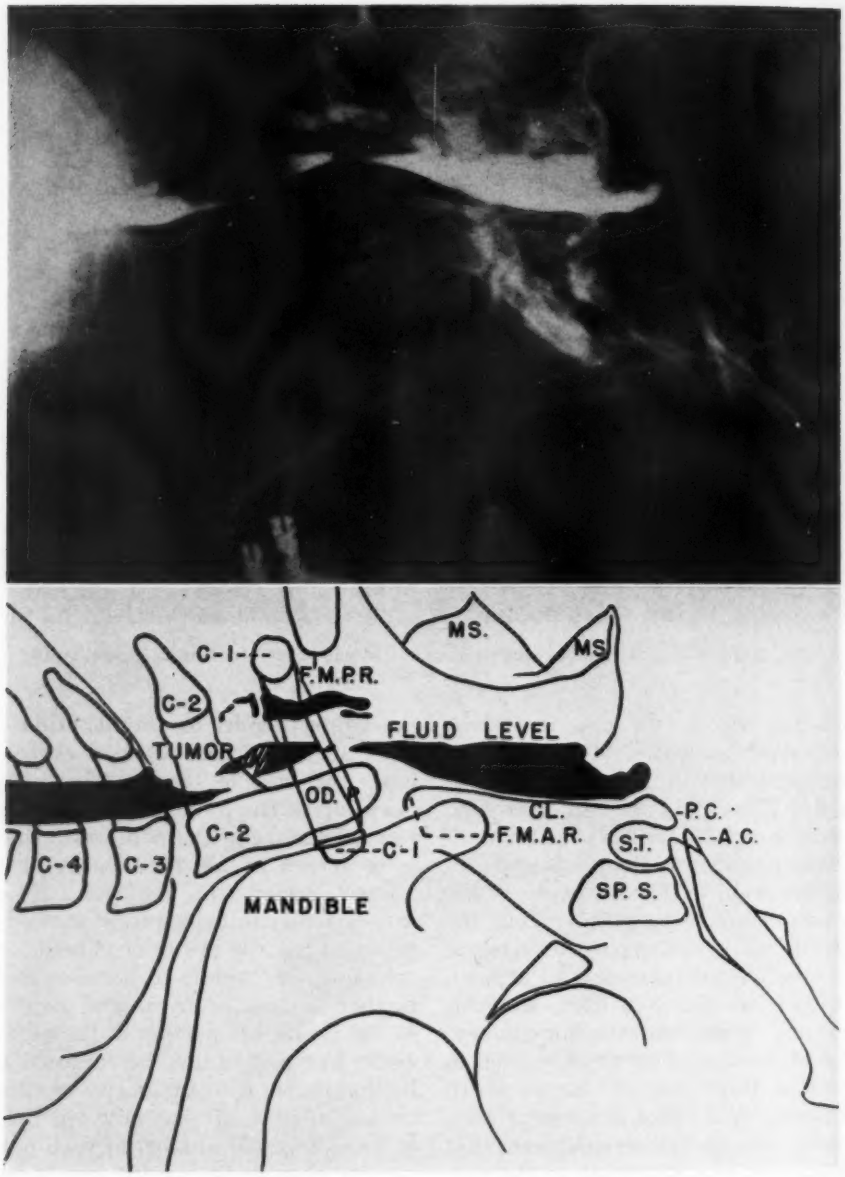


Fig. 25. Same case as Fig. 24. Cross-table lateral view demonstrating the tumor at C-2.

curring fifteen months after Pantopaque was allowed to enter the skull base, is considered to be due to that medium because of the high content of iodine in the arachnoidal reaction tissue, and the negative cultures. However, meningoencephalitides of many types have occurred without previous spinal injection of any material, and it is reasonable to assume that, if a basilar meningitis occurred, Pantopaque present in the arachnoid at the base would be picked up in the reaction. It could hardly be otherwise.

Other causes than Pantopaque may be

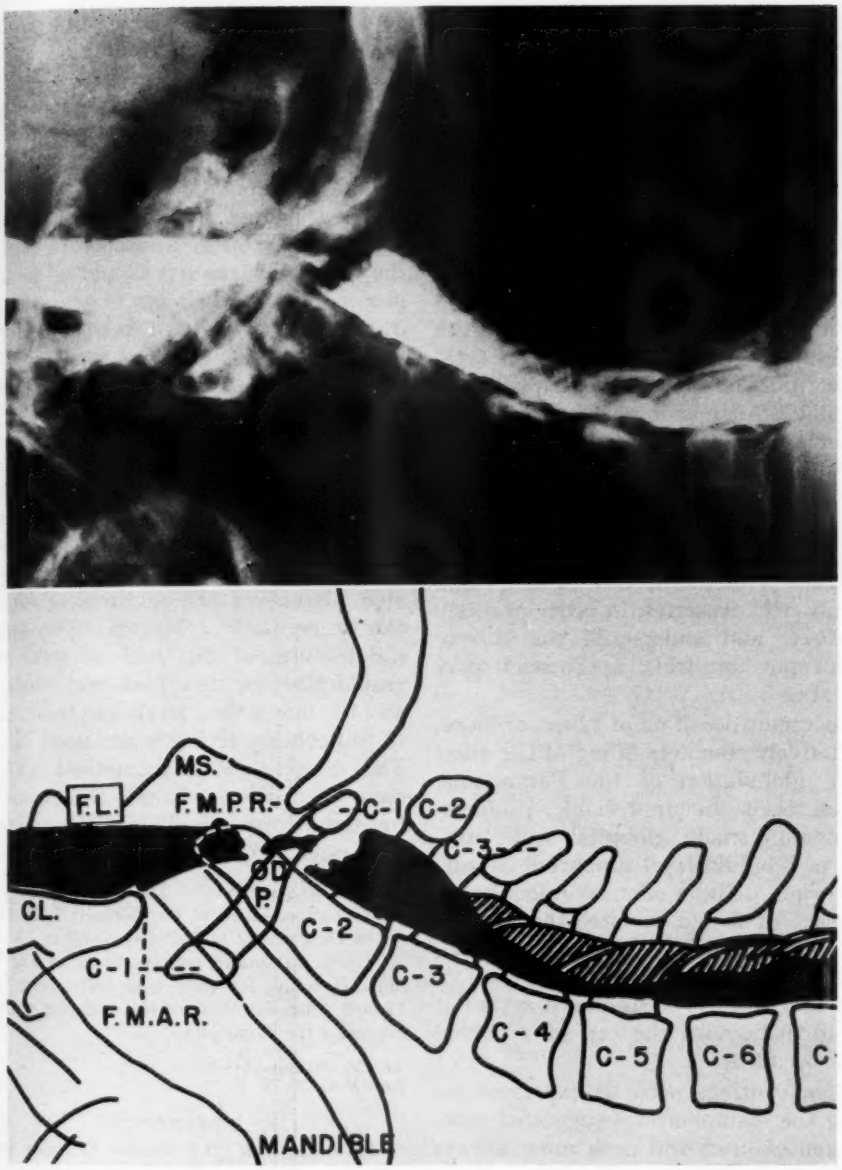


Fig. 26. Cross-table lateral view. Severe subluxation of the altas on the axis, with constriction of the spinal canal at the foramen magnum and incomplete block.

associated with any arachnoidal reaction following an intraspinal procedure. Traces of detergent solutions employed for cleaning syringes have been shown to be a potent causal factor in at least one series of cases (9).

We feel that the so-called danger of intracranial Pantopaque and its relationship to continued syndromes after myelography has been grossly exaggerated and, in fact, does not exist. With adequate technic and the patient's cooperation, however, it

is possible to examine this entire area of foramen magnum and clivus and still recover all of the oil from the intracranial cavity.

The term "fluid level" has been used throughout the description of the technic and the case observations. The presence of a fluid level can mean only that below this meniscus all available fluid space has been filled with the Pantopaque, with the displacement of the spinal fluid. Therefore, any unfilled area, or "defect" in the fluid column, is real, cannot be an artefact, and must be explained or explainable. While not as easy as in the lumbar canal, an attempt has been made here to utilize the same diagnostic principles applied to the full-column technic of study of the lumbar canal (7). This requires considerable reliance on "cross-table laterals," films taken with the horizontal beam and vertically held cassettes, in order properly to evaluate and understand the anteroposterior spot-films which are so much more easily taken.

Using quantities of oil of 12 c.c. or more, and relatively complete filling of the areas studied, globulation of the Pantopaque has not been an appreciable problem. Occasionally small globules will "sit" on top of the fluid level supported by surface tension. These offer no difficulty in diagnosis. It should be noted that the oil-cerebrospinal fluid interface, or fluid level, or meniscus, has its convexity upward, a circumstance which occasionally makes it easier to distinguish the cap of a partial block from a level.

Certain cautions need be expressed regarding the manipulations suggested here. Extension of head and neck must always be carried out with considerable care, as they may not be tolerated well by patients with cervical lesions. Patients who have a Queckenstedt block in hyperextension certainly must not be held in hyperextension at all; extension should be maintained at the minimum needed, particularly by use of a pillow beneath the hips, in bringing the oil up into the cervical region. Serious neurological damage can be produced by the cord compression which results from narrowing of the cervical canal in the extended position.

The presence of bone lesions must be carefully sought. If destructive lesions or fracture dislocations are found, the danger of the manipulation must be carefully weighed against the possible value of the myelographic information before beginning the study. Again, if it should be decided to proceed under such circumstances, great caution should be used in limiting the extent of the manipulation.

SUMMARY

The difficulty and importance of early and accurate diagnosis of benign tumors of the foramen magnum region is known. Technics for myelographic examination of this region are described in considerable detail. By these methods a highly reliable picture of the anatomical situation can be regularly achieved. The anatomical features of the area as seen myelographically are described and illustrated, and the use of fluid levels and their relation to full-column technics has been stressed. The dangers, both theoretical and real, have been discussed, and the remarkable freedom from significant complications is affirmed.

ACKNOWLEDGMENT: The author expresses his grateful appreciation to Dr. Bernard Wolf, Director of the Department of Radiology, and to Dr. Sidney W. Gross, attending neurosurgeon, of The Mount Sinai Hospital, for their help and advice, and to Mynell Allen Smollett for her skill and patience in preparing the illustrations.

The Mount Sinai Hospital
New York 29, N. Y.

REFERENCES

1. BULL, J. W. D.: Positive Contrast Ventriculography. Acta radiol. **34**: 253–268, October-November 1950.

2. DODGE, H. W., JR., LOVE, J. G., AND GOTTLIEB, C. M.: Benign Tumors at the Foramen Magnum: Surgical Considerations. J. Neurosurg. **13**: 603–617, November 1956.

3. ERICKSON, T. C., AND VAN BAAREN, H. J.: Late Meningeal Reaction to Ethyl Iodophenylundecylate Used in Myelography. Report of a Case That Terminated Fatally. J.A.M.A. **153**: 636–639, Oct. 17, 1953.

4. HORWITZ, N. H.: Positive Contrast Ventriculography. A Critical Evaluation. J. Neurosurg. **13**: 300–311, July 1956.

5. LOVE, J. G., THELEN, E. P., AND DODGE, H. W.,

JR.: Tumors of the Foramen Magnum. J. Internat. Coll. Surgeons **22**: 1–17, July 1954.

6. MALIS, L. I., COHEN, I., AND GROSS, S. W.: Arnold-Chiari Malformation. Arch. Surg. **63**: 783–798, December 1951.

7. MALIS, L. I., NEWMAN, C. M., AND WOLF, B. S.: Full-column Technic in Lumbar Disk Myelography. Radiology **60**: 18–27, January 1953.

8. PIEHL, M. R., REESE, H. H., AND STEELMAN, H. F.: The Diagnostic Problem of Tumors at the Foramen Magnum. Dis. Nerv. System **11**: 67–76, March 1950.

9. WINKELMAN, N. W., GOTTEN, N., AND SCHEIBERT, D.: Localized Adhesive Spinal Arachnoiditis. A Study of 25 Cases with Reference to Etiology. Tr. Am. Neurol. A. **78**: 15–18, 1953.

10. WOLF, B. S., KHILNANI, M., AND MALIS, L. I.: The Sagittal Diameter of the Bony Cervical Spinal Canal and its Significance in Cervical Spondylosis. J Mt. Sinai Hosp. **23**: 283–292, May 1956.

SUMMARIO IN INTERLINGUA

Le Examine Myelographic Del Foramine Magne

Le difficultate e le importantia de un precoce e accurate diagnose de tumores benigne in le region del foramine magne es cognoscite. Technicas pro le examine myelographic de iste region es describite in grande detalio. Per iste methodos un fidelissime delineation del situation anatomic pote esser effectuate regularmente. Le aspectos anatomic del area, vidite myelographicamente, es describite e illustrate. Es sublineate le uso de nivellos de fluido e lor relation con technicas a columna complete. Le periculos—tanto theoric como etiam real—es discutite, e le remarcabile non-occurrentia de complicationes significative es confirmate.

Metastatic Lesions to the Large Intestine[1]

RUSSELL WIGH, M.D.,[2] and NORAH duV. TAPLEY, M.D.

A REVIEW OF surgical specimens or operative notes and autopsy material will indicate that metastatic lesions affecting the colon are not uncommon. When the roentgenological features of numbers of such cases are studied, special patterns evolve which may be quite impressive. Familiarity with the changes that are produced by cancer metastases, either in direct contact with the wall of the large intestine or implanted in the mesentery, permits the roentgenologist to offer this opinion as one of highest probability among several that may be considered.

The routes by which metastases reach the colon include: the embolic, either lymphatic or vascular; direct extension, with invasion of the contiguous colon wall; seeding or implantation of malignant cells. This last may occur because of free cells in the peritoneal fluid or because of manipulation of the primary lesion at the time of surgery. It is felt that metastatic implants in the mesentery may produce some functional changes even if the intestinal wall is not directly involved.

The method by which the colon becomes affected is of some significance in explaining the type of lesion produced. Those derived by direct extension will simulate primary carcinoma more closely. In fact, lesions of this type can produce complete retrograde obstruction. In these cases, however, there may exist the knowledge that an adjacent viscus is the site of a primary cancer. Abnormalities produced by seeding or embolization are more likely to be multiple, and eccentric in character; they also may exhibit changes of a pathophysiological nature that are best appreciated by roentgenoscopy.

In the 30 cases reviewed, the ages ranged from thirty-two to eighty-five years. There were 7 males and 23 females. All of the lesions were intra-abdominal or pelvic in origin, except for 2 cases secondary to breast carcinoma and one to squamous-cell carcinoma of the leg. Two patients had had a primary malignant neoplasm of the large intestine but the history and the surgical and pathologic findings indicated that the

Fig. 1: Three abnormal areas are present in the distal large bowel. In the *splenic flexure* there is an elongated narrowed segment with tapering margins merging with normal colon. In the *sigmoid* there is evidence of extrinsic pressure, with reduction in the width of the lumen. The mucosa does not appear unusual. The *rectum* is markedly reduced in caliber. The ends of the lesion are tapered. Partial distensibility was noted in all areas, although it was only slight in the splenic and rectal regions. There is an unusual lobulation along the mesenteric margin of the transverse colon.

History: A 60-year-old white woman complained of intermittent constipation and diarrhea. One year previously she had undergone a mastectomy for carcimona. Proctoscopic biopsy indicated that an ulcerated mass was secondary to carcinoma of the female mammary gland. At postmortem examination, the serosa and mesentery were studded with metastatic tumor. Neoplasm partially encircled the splenic flexure and rectum. Gross mucosal ulceration was not present in the splenic flexure.

[1] From the Department of Radiology of the College of Physicians and Surgeons, Columbia University, and the Radiological Service of the Presbyterian Hospital, New York, N. Y. Presented at the Eighth International Congress of Radiology at Mexico City, Mexico, July 22–28, 1956. Accepted for publication in August 1957.

[2] Present address: Medical College of Georgia, Augusta, Ga.

newly discovered lesions were not additional primary carcinomas but were truly metastatic in type.

Most of the patients were admitted with gastrointestinal symptoms, many of them giving a history of constipation and change in bowel habits. Several had a preceding history of a primary cancer elsewhere. In most of the cases of diffuse carcinomatosis resulting from gastric, pancreatic, and ovarian tumors, the origin of the cancer was not known before surgery or postmortem study. In such patients, when barium-enema examinations were done, it was not usually known that a primary cancer existed outside of the colon. It is of particular interest, therefore, that the roentgenologist did not offer a diagnosis of primary cancer, but more usually of inflammatory disease or, in the more recent cases, of metastasis.

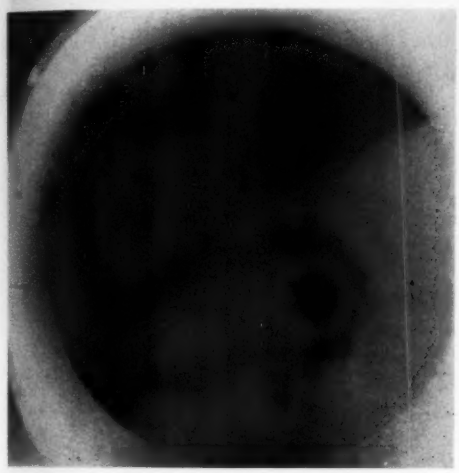


Fig. 2. In the splenic flexure the lumen is narrowed over a short area unilaterally. In the region of the unilateral defect, the mucosa is not effaced but instead is thickened and has a serrated pattern along one margin.

History: A 72-year-old white woman gave a history of increasing constipation over a two-month period, with stools of decreasing size. She was found to have an enlarged liver and ascites. No abnormal masses were palpated. At laparotomy a spherical mass replaced the left ovary and much tumor tissue was present in the pelvis. Extensive omental and peritoneal implants were found. The primary carcinoma was in the ovary and was papillary in type. It is considered that an implant produced the abnormal findings in the splenic flexure.

Fig. 3. Roentgenogram from an area of the sigmoid colon which looped over into the right iliac fossa. It shows a hemispheric defect protruding into the lumen. The surrounding mucosa is normal. The roentgenoscopist noted slight hypertonicity when the barium mixture first entered the area.

History: A 67-year-old white male complained of right lower quadrant pain. One year previously, he had had a partial colectomy of the splenic flexure for adenocarcinoma and a cecostomy. A firm mass could now be felt under the cecostomy scar. In exploration, the sigmoid was adherent to the abdominal wall. The operative specimen included the sigmoid, omentum, and peritoneum, all of which were involved by tumor. A sessile, circumscribed polypoid mass covered by intact mucous membrane extended into the intestinal lumen. Microscopically, the mucosa over a well differentiated adenocarcinoma was found to be intact. Presumably, this lesion was the result of implantation at the time of cecostomy for the splenic flexure carcinoma.

Multiplicity of Lesions: Eleven of the 30 patients in this series had at least two defects, and 5 of these had three or more. In fact, in one instance there were actually six abnormal areas in the colon. Although primary carcinoma of the large bowel can be multicentric (1–6), this is not true of as high a percentage of patients as in this study (37 per cent). Sheinfeld (5) has indicated that multiple primary lesions can be expected in only about 3.5 per cent of cases of carcinoma of the colon. It should be emphasized that in most instances each of the primary lesions can be expected to have those characteristics which clearly identify it as being of bowel origin; the probability, however, of each

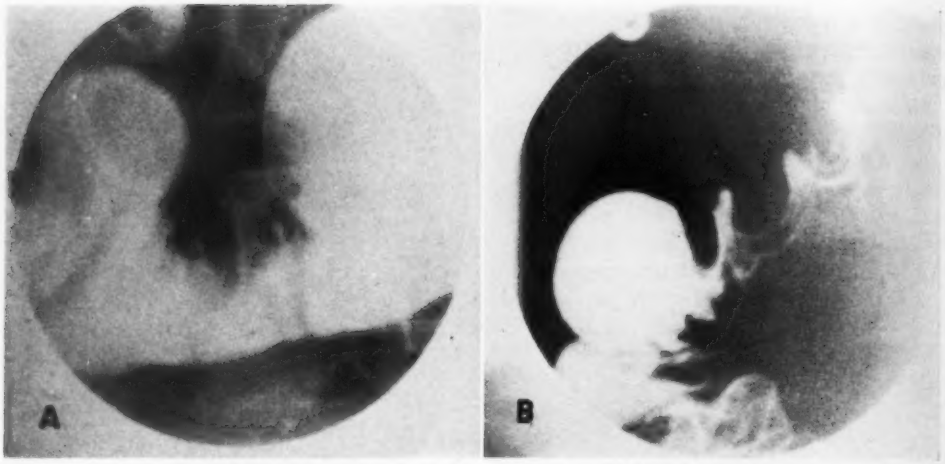


Fig. 4. A. A unilateral defect along the superior border of the proximal transverse colon. The area is incompletely distensible. The folds seen superiorly do not seem compressed from above, so that a serrated appearance is produced. The margins of the defect were flexible (see text).

B. One of several spot films of the distal ascending intestine, showing the appearance in one stage of filling. The pattern was variable; in this example the prominent finding is an unusual lobulation along one margin. On other films, a predominantly unilateral solitary mass lesion is suggested.

History: A 54-year-old Puerto Rican woman was admitted with abdominal pain of one year duration. No abnormalities were found on physical examination. At surgery, abdominal carcinomatosis was seen. Biopsies of several nodules showed them to be adenocarcinoma, unrelated to bowel. The primary site remained unknown.

of multiple metastatic cancers exhibiting findings similar to colonic carcinomas becomes more remote with an increase in their number. Figure 1 illustrates the presence of multiple metastatic lesions.

Annular or Concentric Lesions; Absence of Shelving Margins: There were 17 instances in which the lesions were of annular type, but in which the typical shelving aspect of primary carcinoma was absent. Instead of presenting an abrupt transition between normal and affected bowel wall, the extremities of the defects were tapered or conical (Figs. 1 and 9). It is noteworthy that in more than half of these circumstances absolute rigidity was not present, but some flexibility of the wall was retained. That is, there was incomplete distensibility of the bowel, but contractility still remained. The roentgenoscopist frequently reported the presence of "spasm" or "irritability" in these areas.

In only two patients were the shelving margins, typical of primary carcinomas, seen on initial examination. A third instance of abrupt change from normal to abnormal bowel occurred after an interval of study in which a unilateral lesion progressed to present the appearance of a primary carcinoma.

Unilateral or Eccentric Defects: In areas of narrowing, both concentric and eccentric shadows can be discerned. Unilateral defects were noted in 11 cases (Figs. 2 and 3). There are probably at least three ways in which such a defect can be produced: by local infiltration or invasion of one side of the bowel wall, so that it loses its distensibility; by adjacent infiltration of the mesentery, which may result in reflex spasm of the intestinal wall; by compression and narrowing of the colon by a nodule or mass of tumor tissue implanted in the serosa.

Marginal Serrations and Wall Pliability: Figures 2 and 4A are representative of marginal serrations in unilateral defects. These were noted in 6 patients. They are probably pathophysiological changes. It would seem that an extrinsic mass would tend to obliterate mucosal folds or to flatten them at their extremities. We interpret the unilateral narrowing as a neurogenic response to the presence of a

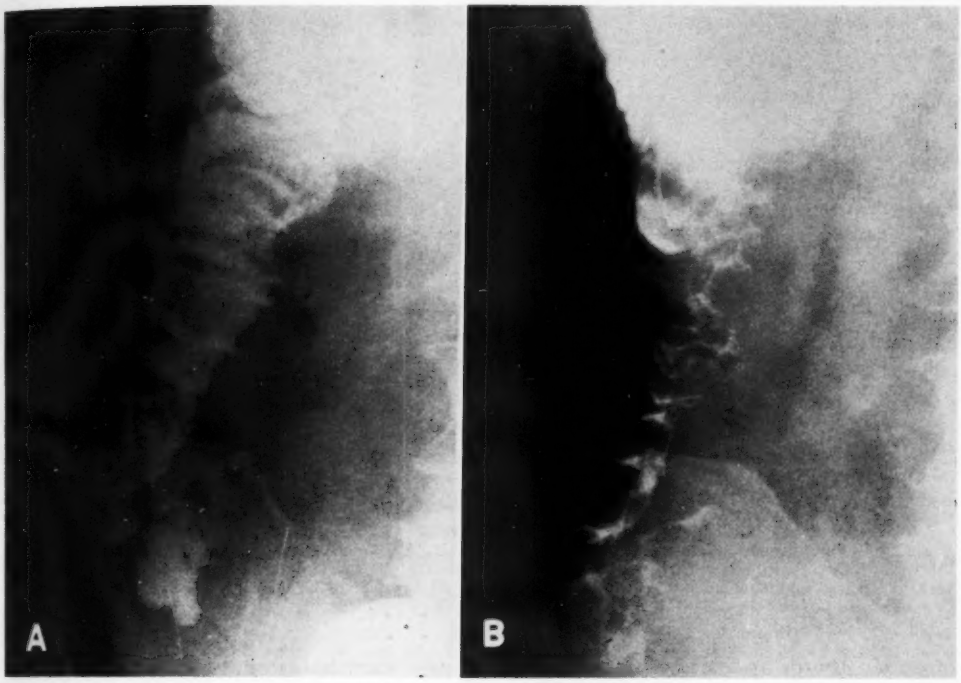


Fig. 5. The cecum and ascending colon at the phase of maximum distensibility (A) and following almost complete evacuation (B). The folds are thick, the bowel contour lobulated. Absence of rigidity is evident, as is a very long segment of abnormality, with absence of sharp margination or shelving. Although the finding suggests hypertonicity, in this instance the inability of the bowel to distend completely is due to "encapsulation" by neoplasm.

History: A 61-year-old white man had experienced marked anorexia accompanied by a loss of weight for the preceding eight weeks. A firm mass was palpated in the right midabdomen. The patient underwent laparotomy without definitive surgery. At necropsy, numerous tumor nodules were found on the peritoneum. The terminal ileum and ascending colon were bound to a mass in the small bowel mesentery, which in turn was invaded from a primary adenocarcinoma of the pancreas.

contiguous mass in the mesentery, rather than the effect purely of pressure. Under the roentgenoscope, we not infrequently

Fig. 6. A portion of the midsigmoid is shown. There is a unilateral defect which appears to be a manifestation of pressure from without. In most areas the folds are compressed along this margin, but more proximally a serrated pattern is produced. During roentgenoscopy, when the segment was completely filled, evidence of a pressure effect was lost. The bowel, therefore, was completely distensible. There is also angular distortion or kinking proximally.

History: A 49-year-old white female had experienced pleuritic pain three weeks before admission and now complained of shortness of breath. There was fluid present in the right hemithorax and a 5-cm. mass was palpated to the right of the uterus. A metastatic nodule near the umbilicus was carcinomatous in type. The patient expired during the sixth hospital week. Postmortem, carcinoma of the right ovary was found. Small tumor nodules were studded over the serosa of the intestine. In the sigmoid area the serosal surface was involved over a long distance, and neoplastic tissue reached to the submucosa. The mucosa was intact. Tumor cells were present in the submucosal lymphatics.

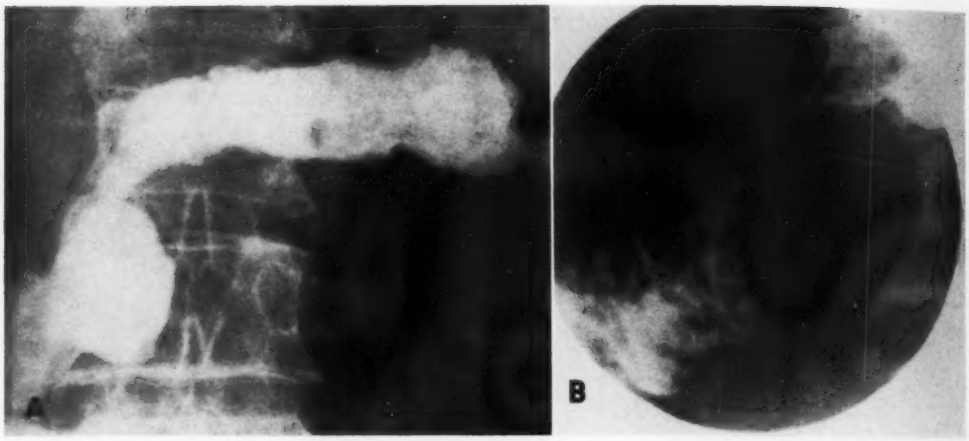


Fig. 7. A. This film indicates the presence of irregular contours of the transverse colon over a long area, with the most marked narrowing proximally. This latter region has a cone-like appearance.

B. There are demonstrated at least some normal folds. Tapering proximally can also be seen. Contractility with incomplete distensibility is evident.

History: A 62-year-old white woman had had an ulcerating carcinoma of the stomach for which partial gastrectomy was performed. Four years later the above abnormality of the transverse colon was found. Two months subsequently exploration was carried out because of impending obstruction. The involved portion of the transverse colon was bound down posteriorly and to the liver and could not be removed. Biopsy of the metastatic process indicated that the cells were of the same type as in the gastric lesion.

observed the disappearance of the "mass" effect in the sense that the bowel walls might again become parallel. At times, it is easier to discern the effect of the metastases upon the colon when the organ is but partially filled, while in the completely distended phase the walls appear normal.

In the case of the deformity demonstrated in Fig. 4, A, the narrowing was not overcome in the completely distended phase. However, the absence of an actual mass in the area of the defect is expressed by the roentgenoscopist's report. "In the distal hepatic flexure and proximal transverse colon, there are two areas of bowel attenuation. The one in the transverse colon narrows the lumen to about half its width. It could not be made to distend any greater than 2 cm., even when more proximal colon was manually obstructed during continuing barium flow. However, the margins of the defect are flexible and manual palpation could reduce the width of the radiotranslucent area. The mucosa is not abnormal. The area will collapse when empty. The change in the hepatic flexure itself is relatively comparable, again being predominantly unilateral. It is not thought that a primary carcinoma is present at either site. The single concept that would fit as an answer would be metastatic cancer fixed to the wall of the colon or being very adjacent in the mesentery."

Encapsulation, Lobulation, Lengths of Abnormality: In the study of some of these abnormalities, particularly those of great length, one begins to consider that large portions of the colon are indeed trapped or enclosed in a sheath not normal to the part. We term this, for purposes of description, encapsulation. For long distances (Fig. 5) the bowel retains only partial distensibility but still can collapse quite well and its mucosal pattern may seem not particularly unusual.

For some reason, again possibly because of an abnormal neurogenic physiological influence, the contours of the intestine may be of a lobulated character. This is quite evident in Figures 1, 4B, and 5, in which, respectively, practically the entire transverse colon superiorly, a section of the distal ascending colon, and the cecum and the ascending colon demonstrate this change.

Fig. 8. A and B are but two of several exposures demonstrating the considerable variation in the appearance of the hepatic flexure. Irritability is the striking finding. The involved section is considered to be 7 cm. in length (partially concealed on B). The lumen could be made to distend to a width of 2 cm. The mucosa, though distorted and probably partially destroyed, is too well preserved for a primary carcinoma of this length.

History: A 50-year-old white woman was admitted with a history of weight loss and anorexia of one year duration and constipation for four months. Masses were palpated in the epigastrium and right upper quadrant. At laparotomy, carcinomatosis of the abdomen was found. The hepatic flexure was involved in a large mass. The biopsy report was that the lesion was undifferentiated and suggestive of a primary tumor in the breast. The appearance was not that of a gastrointestinal cancer.

Obstruction: There were only 2 cases of complete obstruction in the present series, but partial obstruction to the retrograde flow of the barium mixture was present in 9 patients. We consider the latter as instances in which slow filling of the colon was obtained proximal to the area of reduced caliber.

Such hypertonicity was present in some of these 9 patients that it was at first believed that a complete obstruction had been encountered. Under the continuing pressure of the enema, the areas did distend reasonably well. This is further evidence of the abnormal physiology that may be present.

Extrinsic Pressure; Fixation With or Without Kinking: Effects are produced which are quite manifestly an expression of extrinsic pressure. It is interesting, however, that less than half of all of these cases had so easily discernible a sign. Benign neoplasms, of course, produce such changes, but they seem rarely to be associated with fixation of a segment of the bowel and still more rarely with both fixation and kinking. In our group the bowel was considered to be abnormally fixed in position in 15 cases. Only occasionally was angular distortion noted.

Figure 6 demonstrates the findings of extrinsic pressure and kinking; this segment of the colon was considered to be fixed in position.

The Mucosa: Assessments concerning the appearance of folds are not the simplest of roentgenologic problems. We believe, however, that most radiologists would have regarded the patterns as within the limits of normal in at least 20 of the involved regions. There were a score or so of instances in which the folds were irregular, stretched, or thickened but in which we did not consider them totally effaced. In some cases, there were combinations of these changes, and in still others they could not be evaluated because of unsuitable evacuation or inadequate film coverage.

Figure 7, B, demonstrates a portion of the bowel in which the folds are obviously not

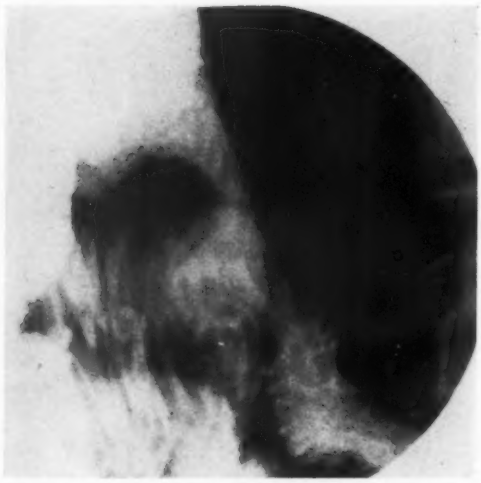


Fig. 9. Pressure film of the distal portion of the hepatic flexure. This segment varied in width, and during roentgenoscopy was considered irritable. Its extremities are tapered rather than shelving. The mucosa, although flattened, seems intact.

History: A 63-year-old white woman gave a history of epigastric and midabdominal distress for one year. Roentgenologic study of the stomach demonstrated an ulcerated carcinoma. Subsequently, a colon examination was done. At operation, the peritoneal cavity contained tumor nodules in the omentum and in the mesentery of the sigmoid and transverse sections of the large bowel. There were nodules over the cecum. A large mass arose from the distal third of the stomach. Tissue biopsies indicated that the lesions were metastatic from a gastric carcinoma.

destroyed, at least in the tapered extremities of the deformity. In Figure 8, A, there is obvious mucosal abnormality, but the alterations are considered insufficient, in relation to the length of the area of involvement, to represent primary carcinoma. Figure 9 shows an intact mucosa with perhaps some flattening. Observations relating to a normal membrane were confirmed frequently at pathological examination; in many instances where the mucosa was found undisturbed, the pathologist did find tumor cells in the submucosal layers or in the adjacent mesentery.

SUMMARY

A study of the roentgenograms of 30 patients in whom metastatic carcinoma affected the large intestine permits one to conclude that the radiologist can offer such a diagnosis with a high degree of confidence. Among the prominent findings, many of them coexisting, are: a multiplicity of lesions; concentric deformities with conical extremities and the absence of shelving margins; unilateral defects, some with marginal serrations, some with wall pliability; extensive areas of encapsulation and of lobulation; extrinsic pressure defects, some associated with fixation and with angular distortion; uneffaced mucosa and pathophysiological changes, the more notable being incomplete distensibility with preserved contractility, hypertonicity, and unilateral contractility.

Medical College of Georgia
University Place
Augusta, Ga.

REFERENCES

1. ABELL, I.: Carcinoma of the Colon. South. M. J. **26:** 64–71, January 1933.
2. BERSON, H. L., AND BERGER, L.: Multiple Carcinomas of the Large Intestine. Surg., Gynec. & Obst. **80:** 75–84, January 1945.
3. BRINDLEY, G. V.: Multiple Primary Malignancies of the Large Intestine. South. M. J. **31:** 355–362, April 1938.
4. MARSHAK, R. H.: Multiple Carcinomas of the Large Bowel. Radiology **54:** 729–731, May 1950.
5. SHEINFELD, W.: Synchronous Colon Carcinomas of Multicentric Origin. New York State J. Med. **48:** 85–87, Jan. 1, 1948.
6. WARREN, S., AND GATES, O.: Multiple Primary Malignant Tumors. A Survey of the Literature and a Statistical Study. Am. J. Cancer **16:** 1358–1414, November 1932.

SUMMARIO IN INTERLINGUA

Lesiones Metastatic Del Intestino Crasse

Un studio del roentgenogrammas de 30 patientes in qui carcinoma metastatic afficeva le intestino crasse permitte le conclusion que le radiologo pote offerer ille diagnose con un alte grado de confidentia. Le constatationes prominente—multes occurrente in co-existentia—include: Un multiplicitate de lesiones; deformitates concentric con extremitates conic e absentia de margines scamnate; defectos unilateral, certes con serration marginal, alteres con plicabilitate parietal; extense areas de

incapsulation e de lobulation; defectos de pression extrinsec, in certe casos associate con fixation e con distortion angular; mucosa non-effaciate; e alterationes pathophysiologic, incluse—notabilemente—incomplete distensibilitate con contractilitate intacte, hypertonicitate, e contractilitate unilateral.

Chest Film Findings in Neonatal Respiratory Distress[1]

GUNTER SCHULTZE, M.D.

THE VALUE of roentgenographic chest studies of very young infants has been increasingly appreciated (8, 9, 12, 18, 21, 22). Early recognition of the causes of neonatal distress may help to reduce the considerable mortality and morbidity which are predominantly due to pulmonary disease in this age group (5). The present paper is another attempt to demonstrate a correlation of roentgenographic patterns with different pulmonary disease processes.

In the five-year period 1952 through 1956, chest films were taken on 116 neonatal (less than one month old) patients because of the clinical impression of respiratory distress (excluding congenital cardiovascular causes). Of these, 16 were discarded from this study because of technically unsatisfactory films. Analysis of the remaining 100 sets of films indicated that they might be divided into groups on the basis of their roentgenographic patterns (Table I).

TABLE I: FINDINGS ON CHEST FILMS OF 100 INFANTS LESS THAN ONE MONTH OLD

	Cases	Deaths
Bilateral coarse, diffuse, irregular densities	20	3
Reticulogranular densities	20	8
Miscellaneous patterns:		
(*a*) Lobar infiltrations	3	..
(*b*) Pneumothorax	3	1
(*c*) Rounded, radiolucent lesions	4	1
(*d*) Changes suggesting massive atelectasis	3	2
Normal chests	47	..
TOTAL	100	15

BILATERAL COARSE, DIFFUSE, IRREGULAR DENSITIES

20 infants; 3 deaths

The films comprising the first group listed in the accompanying table most frequently exhibited irregular linear shadows, often in bronchial distribution, radiating into the lung fields from the hili. Nodular and small patchy densities diffusely distributed through both lungs, many times with central accentuation and without the linear component, were also observed. Larger, usually ill defined, shadows were sometimes superimposed on this pattern. In about one-half of the cases, these infiltrations were accompanied by generalized hyperaeration. No pleural involvement or hilar adenopathy was observed (Figs. 1–3). The increased pulmonary vascular markings seen in many congenital cardiovascular conditions may simulate this pattern closely.

Of the total number of patients studied, 20 fell within this group. Ten of these exhibited immediate postnatal respiratory distress, and 10 did not demonstrate such findings until after the lapse of some time. The first category included 2 premature and 8 full-term infants; in the latter were 5 premature and 5 full-term infants.

Immediate Postnatal Respiratory Distress: Of the 2 premature infants, 1 recovered within forty-eight hours; the other died at two weeks of age of *Bacillus pyocyaneus* bronchopneumonia (Fig. 1). In these cases there were histories of premature rupture of the membranes for ten and thirty days.

All 8 full-term infants had definite evidence of considerable meconium in the upper respiratory tract after birth. All but 1 showed good evidence of fetal distress during birth. Six recovered clinically, with roentgenographic clearing, in five to nine days. One recovered clinically and the lungs were cleared roentgenographically in eight hours. One died after four days; autopsy showed meconium bronchopneumonia (Fig. 2).

[1] From the Department of Radiology, The Johns Hopkins Hospital, Baltimore, Md. Accepted for publication in August 1957.

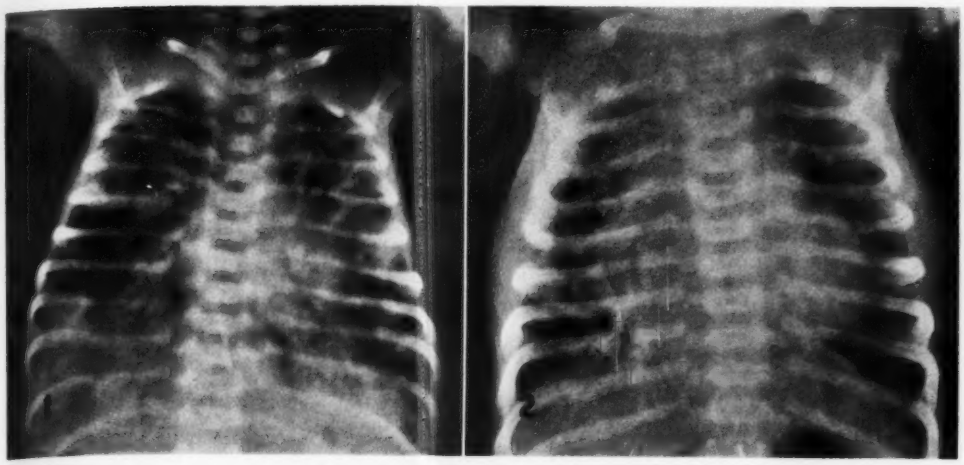


Fig. 1. An infant, one of triplets, weighing 1,210 gm., with proved *Bacillus pyocyaneus* bronchopneumonia probably contracted *in utero*. There was a history of premature rupture of membranes. Siblings died of similar pulmonary infections.

Fig. 2. A 3-day-old infant weighing 2,725 gm., with marked fetal distress at birth. The amniotic fluid had been deeply stained with meconium. Proved meconium bronchopneumonia.

Delayed Respiratory Distress: Five premature infants had no respiratory difficulties until four to fourteen days postnatally. Of these, 3 recovered in from four to twenty days, and 1 in six weeks (Fig. 3); 1 died of aspiration pneumonia following meningitis, without evidence of pulmonary infection.

Of the 5 full-term infants, 3 were entirely well from two to three days postnatally. Two of these were admitted with signs of pulmonary infection which responded to antibiotics in four to eight days. The third had subarachnoid hemorrhage concurrent with respiratory difficulties, and respirations continued to be abnormal for two weeks. The fourth infant was well for two weeks postnatally, was febrile and acutely ill on admission, but recovered in four days. The fifth became distressed about twenty-four hours following birth and was well within four days. Labor, delivery, and postnatal course were unremarkable.

In none of the cases of delayed respiratory distress was there a history of meconium-stained amniotic fluid or premature rupture of the membranes.

Comments: Bilateral, coarse, irregular densities appear to be predominantly

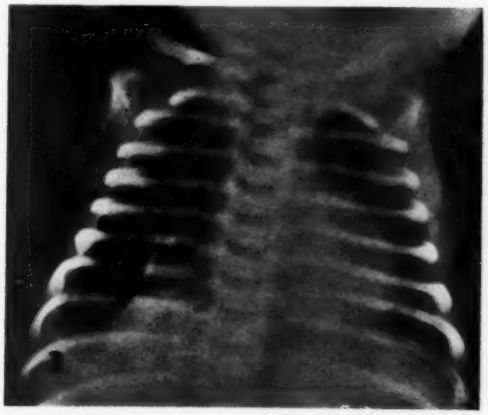


Fig. 3. A 3-week-old infant weighing 1,740 gm., with *Bacillus pyocyaneus* septicemia and probable *B. pyocyaneus* bronchopneumonia. The bleb in the right base persisted almost unchanged for two weeks.

associated with bronchopneumonic processes. It is probably not possible to decide from the chest films alone whether these processes are infectious or noninfectious. With adequate clinical information, however, the cause of the abnormal x-ray pattern is often suggested. Immediate postnatal respiratory distress should lead one to suspect prenatal pulmonary infection, meconium aspiration, or a combination of the two. Premature

Fig. 4. A 3-day-old infant weighing 1,800 gm., recovering from extreme respiratory distress which began a few hours after birth.

rupture of the membranes resulting in infection of the amniotic fluid is a frequent cause of prenatal pulmonary infection, while long labors and complicated deliveries may result in pulmonary infection or meconium aspiration. Meconium aspiration is probably less likely to occur in premature than in full-term infants. The rapid clearing of meconium bronchopneumonia and its association with postmaturity as described by Peterson and Pendleton (18) were not observed. When respiratory distress is delayed for hours to days postnatally, aspiration of feedings or pulmonary infection should be considered.

RETICULOGRANULAR DENSITIES
20 infants; 8 deaths

Fine, diffuse, reticular opacifications usually involving both lungs simultaneously were shown on the films of 20 infants. This pattern has been previously described and named (9, 8, 18 and 21). The reticular effect is produced by spaced, rounded areas of lucency, of pinhead size, within the opaque area. Atelectasis of some alveoli, alveolar ducts, and respiratory bronchioles with overdistention of others, as observed by Claireaux, could produce such a pattern and prevent loss of volume in the lungs in spite of the widespread collapse, at least in the earlier stages of the disease (Fig. 4). With progression, there is increasing loss of volume, with almost complete opacification of the lungs. Frequently, however, the air shadows of the main, segmental, and often of the smaller bronchi, remain visible throughout (Fig. 5). Pathologically, the lungs at this stage are airless, dark red-purple in color, and of liver-like consistency, and will sink in water (4, 19). The terminal coarse and irregular pattern described by Donald and Steiner (9) was not observed in our series. Pleural involvement and visible mediastinal interstitial emphysema were not present. Heart size was within normal limits in all cases and no other radiologic signs of cardiac failure were observed. Progressive liver enlargement during the period of respiratory distress was clinically observed in 2 infants. Predominantly unilateral involvement (Fig. 6) was seen in 2 cases, but this may have been only temporary as no follow-up films were available.

Eighteen of the 20 infants were premature as judged by their weight and the estimated date of confinement. The weights of the premature infants ranged from 1,420 to 2,480 gm.; 6 were born by cesarean section, as was 1 full-term baby. About one-half of the infants received no oxygen in any form before respiratory distress set in. There was no history of meconium-stained amniotic fluid or fetal distress before birth. Premature rupture of the membranes had occurred in 1 instance.

Ten of the infants in this group had *respiratory distress immediately following birth.* In only 2 of this number was there a normal vertex delivery, and 1 had signs suggesting pneumonia and a history of prematurely ruptured membranes. One was born by precipitous delivery, 3 by breech delivery, and 4 by cesarean section—all under general anesthesia. Five of these children were proved to have diffuse hyaline membrane disease at autopsy.

Nine infants had *clinically normal respiration from one to thirty-six hours postnatally,* the majority from sixteen to twenty-four hours. In this group there

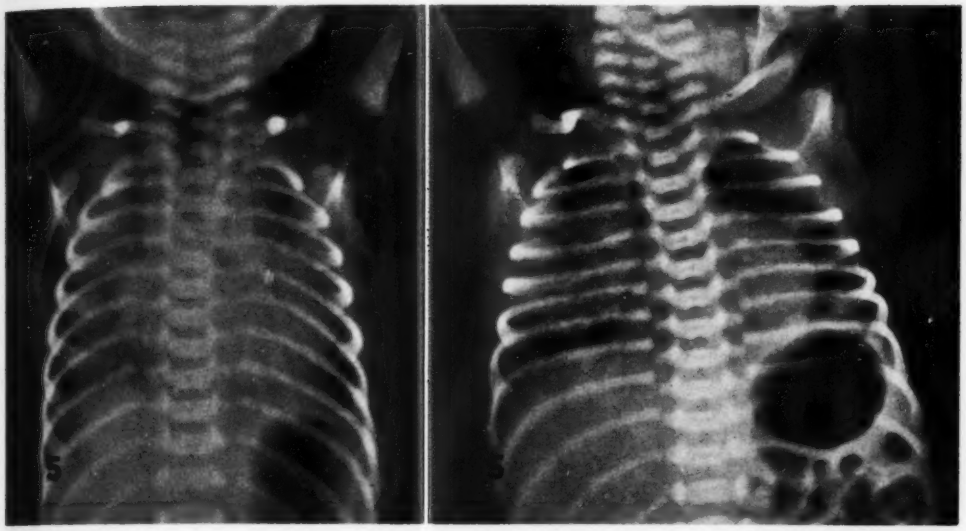


Fig. 5. A 2-day-old infant weighing 1,460 gm., who died of extensive hyaline membrane disease the following day. Note decreased volume of the thorax, the marked generalized opacification of the lungs, and the visible bronchial air shadows.

Fig. 6. A 16-hour-old twin weighing 1,420 gm. There was marked respiratory distress soon after birth with complete recovery within twenty-four hours. After remaining well for the next two days, the child died suddenly of massive intra-alveolar hemorrhage.

The sibling died of extensive hyaline membrane disease.

had been 6 normal vertex deliveries and 3 cesarean sections, of which 2 had been done under local anesthesia.

In the surviving patients, with 1 exception, the respiratory difficulties did not persist for more than six days. Two recovered in six days, 5 in five days, 1 in four days, 2 in three days, and 1 in ten hours. The patient who had signs of pneumonia required sixteen days to recover completely and was the only one to show mediastinal shift due to extensive atelectasis in later films.

One infant died seven hours, 1 ten hours, 1 twenty-four hours, and 3 seventy-two hours after birth. The essential pathologic findings in all were diffuse hyaline membrane formation associated with varying degrees of focal atelectasis. A twin of one of these infants, after recovering fully from earlier severe respiratory distress within twenty-four hours (Fig. 6), suddenly displayed extreme dyspnea, with blood oozing from the nose shortly before death, ninety-six hours after birth. Autopsy showed diffuse hemorrhagic consolidation of the lungs and focal atelectasis without hyaline membrane formation.

Figure 7 shows a pattern which superficially resembles the reticulogranular type of involvement. This infant died of massive interstitial emphysema. There was a history of precipitous labor and marked postnatal dyspnea.

Comments: The essential pathologic finding in one-third of the infants showing the reticulogranular pattern was diffuse hyaline membrane disease with secondary atelectasis in varying degree; associated pneumonia or significant hemorrhages were not reported. The clinical data for the surviving infants, except in 1 case of probable pulmonary infection contracted *in utero*, are entirely compatible with hyaline membrane disease. The well known association with prematurity and/or cesarean section, and limitation of the disease to the first five to six days of life were observed in all cases.

In the large majority of infants less than six days old, the reticulogranular pattern is probably associated with hyaline mem-

brane disease. Meconium aspiration (18), diffuse pulmonary infection, extensive interstitial emphysema, residual amniotic fluid (3, 18), and possibly edema and hemorrhage (17) may perhaps produce a similar picture occasionally.

Physiologic neonatal disseminated atelectasis or primary failure of expansion (11) frequently produces a reticulogranular pattern, according to Caffey. However, there is increasing radiologic and pathologic evidence that, in the absence of obstructive material in the air passages, the lungs in the newborn normally expand promptly and uniformly (9, 18–22), except in very premature infants. Thus, disseminated neonatal atelectasis is secondary to obstruction and resorption of air, rather than primary failure of expansion. The reticulogranular pattern should, therefore, not be considered physiologic, in spite of the fact that the lungs clear spontaneously in 60 to 80 per cent of cases.

About one-half of the infants had respiratory difficulties from birth and the "latent period" of normal respiration often cited as characteristic of the condition (19) was not observed in these. Whether the high incidence of abnormal deliveries in this group or hyaline membrane disease was responsible is uncertain, but the "latent period" cannot be considered a constant feature. The high mortality among these infants is noteworthy.

The cause and mechanism of hyaline membrane disease are not understood. Recent evidence (10, 15, 16) and the presence of similar membranes in a wide variety of pulmonary diseases in adults and children (19), apparently as a secondary phenomenon, point to an endogenous origin. The clinical and radiological information obtained in this series gives no indication of the cause of hyaline membrane disease, or, indeed, whether respiratory distress is caused by hyaline membranes *per se* or is due to as yet unknown changes interfering with respiratory function, which result in hyaline membrane formation. According to Feinberg, the reticulogranular pattern may appear before the onset of dyspnea, which suggests that mechanical rather than preceding chemophysical processes are responsible. This series shows no correlation with detectable heart failure, oxygen administration, or prenatal distress.

MISCELLANEOUS PATTERNS

Lobar Infiltration (3 infants; no deaths): In 3 cases the infiltrations were unilateral, without hilar enlargement or disturbance of aeration. Complete lobar opacification occurred only in 1 case of proved staphylococcal pneumonia with associated empyema (Fig. 8).

All 3 babies were well until six to ten days of age when signs and symptoms suggesting pneumonia developed. All recovered clinically, with roentgenographic clearing within two weeks.

Pneumothorax (3 infants: 1 death): Pneumothorax occurred in 3 well developed, full-term babies, and in 2 was associated with serious systemic disease. The 1 death was caused by renal failure.

Rounded Radiolucent Lesions: (4 infants; 1 death): Rounded radiolucent areas, observed in 4 infants, represented diaphragmatic hernia in 3 and congenital cystic disease of the lung, of adenomatoid type, (mistakenly interpreted as diaphragmatic hernia) in the fourth (Fig. 9). This last infant was in severe respiratory distress from birth and lived for only six hours.

Changes Suggesting Massive Atelectasis (3 infants; 2 deaths): Two infants had, as expected from the films, extensive unilateral atelectasis, while a third (Fig. 10) had a large right diaphragmatic hernia with prolapse of the right lobe of the liver and the right adrenal into the thorax, and atelectasis of the entire right lung.

Comments: Localized pneumonias are much less common in infants than the generalized form, and in their presence, especially when associated with pleural fluid, staphylococcal infection should be considered. According to Disney *et al.* an infant under two years has more than 3 chances to 1 of having staphylococcal pneumonia if the infiltration is definitely

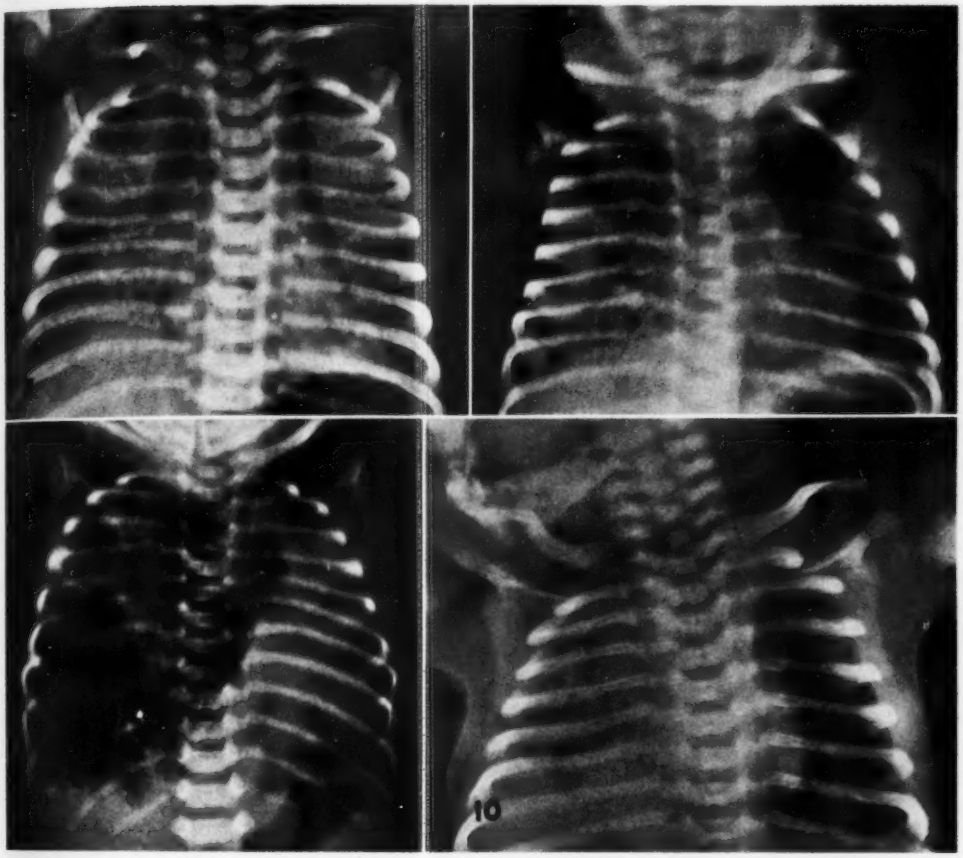


Fig. 7. A 10-hour-old infant weighing 3,030 gm. who died three hours later of massive interstitial emphysema, probably induced by positive pressure oxygen resuscitation. Pathologically, there was no evidence of hyaline membranes, aspiration, or infection. Note the coarse granular pattern and subpleural, and probably mediastinal, air outlining some of the lobes.

Fig. 8. An 11-day-old full-term infant with proved staphylococcal pneumonia. Note the extensive consolidation of right lung and pleural fluid along right lateral chest wall. These changes are very suggestive of early staphylococcal pneumonia.

Fig. 9. A 3-hour-old infant weighing 2,025 gm., with congenital cystic disease, adenomatoid type, of the right lung, hypoplasia of the left lung, and hepatosplenomegaly. The right lung weighed 35 gm., the left lung 12 gm. Numerous thick-walled cysts, measuring 0.5 to 1.0 cm. were present in the right lung, mainly in its base. Their epithelium resembled bronchial epithelium but showed interspersed papillary adenomatoid projections. The film was misinterpreted as showing a large diaphragmatic hernia.

Fig. 10. A 5-day-old infant weighing 3,670 gm., with herniation of the right lobe of the liver and right adrenal gland into the right thorax, and associated atelectasis of the right lung. The roentgen findings were misinterpreted as representing massive right atelectasis. Note the mediastinal shift to the side of the diaphragmatic hernia, probably because reduction of the lung volume exceeded the volume of herniated viscera.

localized. In our experience, this ratio would more accurately apply to infants less than three months old.

Potter states that pneumothorax is extremely rare in spontaneously breathing newborn infants who are not subjected to resuscitation involving the introduction of oxygen. It is interesting that in our series all 3 infants with pneumothorax breathed spontaneously and only one received positive pressure oxygen.

NORMAL CHESTS

47 infants; no deaths

Six infants had proved intracranial lesions which were probably responsible for

the respiratory difficulties; 3 had suspected intracranial lesions; 2 were severely dehydrated, and respiratory symptoms disappeared on rehydration. Thirty infants, 21 of them premature, had respiratory distress characterized by irregular breathing, periods of apnea, Cheyne-Stokes type of respirations and/or retractions. These disturbances were of all degrees of severity; some were transient, others disappeared only after days. The remaining 6 infants had moderate to severe, unexplained, persistent regular tachypnea (exceeding 50 respirations per minute) for one to five days.

Comments: In the five-year period under discussion, almost 14,500 infants were born at the Johns Hopkins Hospital and approximately 1,000 infants less than one month old were admitted from the outside, many for respiratory difficulties. Since respiratory distress is one of the most frequent morbid conditions requiring treatment at this age, a total of 116 chest examinations in almost 15,500 infants suggests a conservative attitude toward x-ray diagnosis in the past. The high incidence of negative findings is, therefore, surprising. It should be remembered, however, that many of the described milder respiratory disturbances characterized predominantly by arrhythmias and/or retractions, especially in the premature group, were probably physiologic as Graham *et al.* and Smith have pointed out. Severe dyspnea of this type resulting in cyanosis and convulsions, as exhibited by several infants, are certainly not physiologic; likewise sustained tachypnea is to be regarded with suspicion (6). Yet original and follow-up chest films in these infants were normal and the subsequent clinical course was benign. This should be remembered when the radiologist is asked for an opinion. There is a tendency to over-read neonatal chest films, especially when there is a convincing history of respiratory distress. This is often due to unfamiliarity with the normal appearances. Even when the degree of inspiration is adequate, the markings may appear unduly prominent compared with older children or adults, suggesting a pathological process. The dome-shaped, infantile chest with reduced vertical and increased anteroposterior diameters results in superimposition of these markings. A patent ductus arteriosus in the first few days of life may contribute to the picture (1). The accentuation is increased when the central ray passes through the upper abdomen and a slightly lordotic view is obtained.

SUMMARY

A correlation of clinical, pathological, and roentgenographic chest findings in 100 infants with respiratory distress during the neonatal period was attempted.

Bilateral, diffuse, coarse, irregular densities in the lungs were present in 20 premature and full-term infants. This pattern is predominantly associated with noninfectious and infectious bronchopneumonic processes. Given pertinent clinical information, the etiology of these changes can often be suggested with confidence.

The reticulogranular pattern was seen in 20 infants, 18 of them premature. In approximately one-third of these, autopsy showed generalized hyaline membrane disease. The large majority of infants showing this pattern during the first six days of life probably have hyaline membrane disease and not physiologic disseminated neonatal atelectasis.

Miscellaneous lesions were found in 13 infants. Forty-seven infants had normal chest films in spite of respiratory distress. Several reasons for this are discussed.

601 N. Broadway
Baltimore 5, Md.

REFERENCES

1. ADAMS, F. H., AND LIND, J.: Physiologic Studies on the Cardiovascular Status of Normal Newborn Infants (with Special Reference to the Ductus Arteriosus). Pediatrics **19:** 431–437, March 1957.

2. BLYSTAD, W., LANDING, B. H., AND SMITH, C. A.: Pulmonary Hyaline Membranes in Newborn Infants: Statistical, Morphologic and Experimental Study of Their Nature, Occurrence and Significance. Pediatrics **8:** 5–21, July 1951.

3. CAFFEY, J.: Pediatric X-Ray Diagnosis. Chicago, The Year Book Publishers, Inc., 1956, 3d ed., pp. 269–270.

4. CLAIREAUX, A. E.: Hyaline Membrane in the Neonatal Lung. Lancet **2:** 749–753, Oct. 10, 1953.

5. CLIFFORD, S. H.: Discussion of the Symposium on Neonatal Respiratory Distress Syndromes. Am. J. Roentgenol. **74:** 813–815, November 1955.

6. CROSS, K. W.: Respiratory Patterns in Premature and Newborn Infants. Second Conference on Research in Congenital Malformations, 1954.

7. DISNEY, M. E., WOLFF, J., AND WOOD, B. S.: Staphylococcal Pneumonia in Infants. Lancet **1:** 767–771, May 26, 1956.

8. DONALD, I.: Radiology in Neonatal Respiratory Disorders. Brit. J. Radiol. **27:** 500–503, September 1954.

9. DONALD, I., AND STEINER, R. E.: Radiography in the Diagnosis of Hyaline Membrane. Lancet **2:** 846–849, Oct. 24, 1953.

10. DURAN-JORDA, F., HOLZEL, A., AND PATTERSON, W. H.: A Histochemical Study of Pulmonary Hyaline Membrane. Arch. Dis. Child. **31:** 113–118, April 1956.

11. FARBER, S., AND WILSON, J. L.: Atelectasis of the Newborn: Study and Critical Review. Am. J. Dis. Child. **46:** 572–589, September 1933.

12. FEINBERG, S. B., AND GOLDBERG, M. E.: Hyaline Membrane Disease: Preclinical Roentgen Diagnosis. A Planned Study. Radiology **68:** 185–191, February 1957.

13. GRAHAM, B. D., ET AL.: Physiologic and Chemical Response of Premature Infants to Oxygen-enriched Atmosphere. Pediatrics **6:** 55–71, July 1950.

14. LANDING, B. H.: Pulmonary Lesions of Newborn Infants: A Statistical Study. Pediatrics **19:** 217–223, February 1957.

15. LYNCH, M. J. G., AND MELLOR, L. D.: Hyaline Membrane Disease of Newborn Premature Lungs: A New Approach. J. Pediat. **47:** 275–286, September 1955.

16. LYNCH, M. J. G., MELLOR, L. D., AND BADGERY, A. R.: Hyaline Membrane Disease: Its Nature and Etiology. The Poisonous Metabolic Effects of Excess Oxygen. Neural Control of Electrolytes. J. Pediat. **48:** 602–631, May 1956.

17. MITCHELL, A. G., AND NELSON, W. E.: Textbook of Pediatrics. Philadelphia and London, W. B. Saunders Co., 5th ed., 1950, p. 341.

18. PETERSON, H. G., JR., AND PENDLETON, M. E.: Contrasting Roentgenographic Pulmonary Patterns of the Hyaline Membrane and Fetal Aspiration Syndromes. Am. J. Roentgenol. **74:** 800–813, November 1955.

19. POTTER, E. L.: Pulmonary Pathology in the Newborn. [In]: Advances in Pediatrics, Vol. 6, edited by S. Z. Levine, *et al.* Chicago, The Year Book Publishers, Inc., 1953, pp. 157–187.

20. SMITH, C. A.: Neonatal Physiology for the Roentgenologist. Am. J. Roentgenol. **74:** 791–795, November 1955.

21. STEINER, R. E.: The Radiology of Respiratory Distress in the New Born. Brit. J. Radiol. **27:** 491–499, September 1954.

22. WILLIAMS, E. R.: Radiology of the Newborn Infant. Proc. Roy. Soc. Med. **49:** 737–748, October 1956.

SUMMARIO IN INTERLINGUA

Constatationes Thoraco-Roentgenographic In Angor Respiratori De Neonatos

Esseva interprendite un correlation del constatationes thoracic—clinic, pathologic, e roentgenographic—in 100 infantes con angor respiratori durante le periodo neonatal.

Grossier densitates irregular diffuse, presente bilateralmente in 20 infantes prematur e nascite a termino, es associate predominantemente con processos bronchôpneumonic. Si adequate informationes clinic es providite, le causa del anormal configuration roentgenographic pote esser suggerite. Angor respiratori immediatemente post nato justifica le suspicion de prenatal infection pulmonar, de aspiration de meconio, o de un combination del duo. Quando le angor respiratori es retardate per horas o dies post nato, aspiration de alimento o infection pulmonar debe esser prendite in consideration.

Le configuration reticulogranular esseva vidite in 20 infantes, incluse 18 prematur. Le necropsia revelava generalisate morbo a membrana hyalin in circa un tertio de iste casos. Il es probabile que le grande majoritate del infantes qui exhibi iste configuration durante le prime sex dies del vita ha morbo a membrana hyalin e physiologic disseminate atelectasis neonatal.

Lesiones miscellanee esseva trovate in 13 infantes. In 47, le roentgenogrammas thoracic esseva normal in despecto del presentia de angor respiratori.

A Comparative Evaluation of the Newer Contrast Media for Excretory Urography[1]

MAURICE TATELMAN, M.D., and RAINER S. PAKUSCH, M.D.

IN THE PAST several years there has been a considerable renewal of interest in the development of new contrast materials for excretory urography which might improve the radiographic density of the excreted material and might also be better tolerated by the patient than those substances in use for many years. The first of these newer substances was Urokon (sodium acetrizoate) in 30 per cent solution, as reported by Nesbit and Lapides in 1950 (1). Subsequently a 70 per cent solution of the same compound was tried by various authors including Barry and Rose (2) and Nesbit and Nesbitt in 1953 (3). Finally a concentration of 50 per cent became more popular, following its introduction in 1954. The reports of the investigators cited, as well as of others, attested to the greater efficiency of Urokon as compared with the older contrast materials, especially Diodrast (iodopyracet) and Neo-Iopax (sodium iodomethamate).

Early in 1955 we were asked by the Winthrop Chemical Co. to evaluate another new contrast material, bearing the trade name Hypaque (sodium diatrizoate), which was being investigated at the same time in other hospitals. It was immediately apparent that a careful appraisal of this new medium could be obtained only by direct comparison, in respect to relative efficiency and safety, with other contrast substances already in use. A comparative study was therefore undertaken of Hypaque 50 per cent, Urokon 50 per cent, and Neo-Iopax 50 per cent (this last having been our standard medium for excretory urography for approximately ten years).

While the investigative study was being carried out, two other new compounds made their appearance. These were Renografin (mixture of sodium and methylglucamine salts of diatrizoate), of which we learned in the summer of 1955, and Miokon 50 per cent (sodium diprotrizoate), which came to our attention late in 1955. To make a more complete investigation, it was considered necessary to add these compounds to our clinical studies.

TABLE I: IODINE CONTENT OF UROGRAPHIC CONTRAST MEDIA TESTED

	50% Neo-Iopax (Sodium Iodomethamate)	50% Urokon (Sodium Acetrizoate)	50% Miokon (Sodium Diprotrizoate)	50% Hypaque (Sodium Diatrizoate)	76% Renografin (Sodium and Methylglucamine Diatrizoate)
Amount injected	20 c.c.	20 c.c.	20 c.c.	20 c.c.	20 c.c.
Per cent I_2/weight in dry salt	51.5%	65.8%	57.3%	59.87%	59.74%
Per cent I_2 in gm./c.c. of solution	25.75%	32.9%	28.65%	29.93%	37.1%
Grams of I_2 injected	5.15 gm.	6.58 gm.	5.73 gm.	5.99 gm.	7.42 gm.

Many articles have been published detailing the efficacy and safety of Hypaque (4, 5), Renografin (6–8), and Miokon (9, 10), but only one survey has appeared giving a direct comparison of the various media (11), and this does not include an evaluation of Miokon. It is felt to be of value, therefore, to publish the results of our study of these newer media.

Since numerous recent articles have detailed the chemical composition, pharmaceutical action, preliminary animal tests, and other basic information on all of the above compounds, these data will be omitted from the present publication. Table I gives a few essential details of the

[1] From the Department of Radiology, Wayne State University College of Medicine and Receiving Hospital, Detroit, Mich. Accepted for publication in August 1957.

TABLE II: EVALUATION OF RADIOGRAPHIC QUALITY OF EXCRETORY PYELOGRAMS

Quality of Pyelograms	Neo-Iopax 50%		Urokon 50%		Miokon 50%		Hypaque 50%		Renografin 76%	
	No.	%	No.	%	No.	%	No.	%	No.	%
Non-visualization	12	3.8	2	1.3	1	0.4	11	3.2	8	1.3
Poor visualization	88	27.6	21	13.8	25	8.8	37	10.7	64	10.2
Fairly good	164	51.6	55	36.2	79	28.1	92	26.7	196	31.1
Good to excellent	54	17.0	74	48.7	176	62.7	205	59.4	362	57.4
Total satisfactory (fair to excellent)	218	68.6	129	84.9	255	90.8	297	86.1	558	88.5
Total unsatisfactory (poor or non-visualization)	100	31.4	23	15.1	26	9.2	48	13.9	72	11.5
Per cent satisfactory excluding non-visualization	218/306	71.3	129/150	86.0	255/280	91.0	297/334	89.0	558/622	89.6
Total no. cases injected	318		152		281		345		630	

composition of the various compounds and particularly their iodine content.

METHOD

A total of 1,726 injection studies were done with the various contrast media: 318 with Neo-Iopax, 152 with Urokon, 281 with Miokon, 345 with Hypaque, and 630 with Renografin. The cases were not selected in any way, and the different contrast materials were used more or less at random. No attempt was made to include the same number of cases in each group, as we were governed by the available supply of each of the contrast media. In order to standardize the procedure, all patients received the same amount of each compound used, 20 c.c. being introduced intravenously in exactly sixty seconds (except in the occasional case where the patient reaction was so pronounced that the injection had to be slowed). Films were exposed at five, ten, and fifteen minutes following the injection, and the radiographic quality was subsequently evaluated without prior knowledge of the compound employed. So far as possible, extraneous matters, such as bowel gas, overall film density or quality, and other technical factors, were discounted and the attempt made to evaluate only the contrast produced by the excreted material.

A careful record was kept in each case as to the presence of any local or systemic reaction, no matter how mild. The patient received no special preparatory drugs before injection, and only the rare severe reaction or truly allergic response (particularly urticaria) was given any drug or other treatment. All other reactions subsided quite promptly and spontaneously. Preliminary testing in all cases was carried out by means of the conjunctival test. (The effectiveness of such testing will be the subject of another report.)

RESULTS

The radiographic quality of the pyelograms was graded as follows: (1) no visualization, (2) poor visualization, (3) fairly good (satisfactory) contrast density, (4) good to excellent contrast density. The last group was reserved for those cases in which the quality seemed to approach that usually expected with retrograde pyelography, *i.e.*, a relatively dense shadow with well defined contrast as compared to the surrounding structures. The other categories are self-explanatory.

Table II presents the results of this evaluation, including the percentage of total studies considered satisfactory for interpretation and also the percentage with satisfactory visualization when the cases showing no visualization are excluded (since it is felt that such cases would probably fail to show excretion no matter what material was used). It is immediately apparent from the figures given that all of the newer contrast media (*i.e.*, all of those studied with the exception of Neo-Iopax) had a fairly similar percentage of

TABLE III: FREQUENCY OF PATIENT REACTION TO UROGRAPHIC CONTRAST MEDIA

Patient Reactions	Neo-Iopax 50% No.	%	Urokon 50% No.	%	Miokon 50% No.	%	Hypaque 50% No.	%	Renografin 76% No.	%
Nausea and/or vomiting										
Mild	21	6.6	23	15.2	36	12.8	34	9.7	52	8.3
Moderate to severe	11	3.5	2	1.3	8	2.8	4	1.2	13	2.1
Vasomotor reactions										
Mild	1	0.3	1	0.7	1	0.4	0	0	1	0.1
Severe	0	0	0	0	1	0.4	0	0	0	0
Arm or shoulder pain										
Mild	18	5.7	0	0	7	2.5	3	0.9	6	1.0
Moderate	12	3.8	0	0	4	1.4	0	0	0	0
Urticaria	0	0	4	2.6	3	1.1	3	0.9	4	0.6
Sneezing	1	0.3	0	0	2	0.7	0	0	1	0.1
Asthmatic breathing	0	0	0	0	1	0.4	0	0	0	0
Choking	0	0	0	0	0	0	1	0.3	0	0
Cases with more than one type of reaction	1	0.3	0	0	3	1.1	0	0	1	0.1
Total cases with reactions (1 or more)	63	19.9	30	19.8	60	21.4	45	13.0	76	12.1
Total cases injected	318		152		281		345		630	

satisfactory contrast, although Urokon tended to be slightly less effective than Miokon, Hypaque, and Renografin, especially since Urokon showed a definitely lower percentage of good to excellent studies than did the other three. Miokon tended to show a slightly higher percentage of excellent studies than any of the other media. It may be added, parenthetically, that the shadows seen with Hypaque in the good to excellent group were probably a little more on the excellent side than those obtained with Renografin, although it was felt that the difference was not sufficient to warrant any more detailed breakdown in quality than is given here. It is apparent that Neo-Iopax did not approach any of the other contrast materials in the quality of pyelograms produced.

Reactions to the intravenous injection of the various materials investigated are tabulated in Table III. With Hypaque and Renografin the incidence of total reactions was markedly lower than with any of the other compounds investigated. It is particularly notable that the percentage of cases showing nausea and vomiting was considerably greater with Urokon and Miokon than with the other three media and that the incidence of arm or shoulder pain was significantly higher with Neo-Iopax than with the others, though pain was of fairly frequent occurrence with Miokon. Not indicated in the table is the fact that in many cases the nausea and vomiting with Miokon were of such severity that injection had to be slowed considerably, so that it was sometimes impossible to give the full dose in less than three or four minutes, a difficulty which was not encountered with any of the other compounds under investigation.

There were perhaps more urticarial reactions in the patients receiving Urokon than in the others, although it is the impression of the authors that such truly allergic reactions will probably occur with similar frequency regardless of which medium is used. Only one severe vasomotor reaction was encountered in the entire series; this occurred with Miokon. The patient recovered promptly, with the usual supportive treatment. It is felt that the occurrence of such severe vasomotor reactions will probably not depend significantly on the type of compound used, since similar reactions have been reported with all of the known urographic contrast media. The authors feel that the variation in patient reaction to these media is found chiefly in the incidence of nausea and vomiting and of arm and shoulder pain. On this basis, Hypaque and Renografin are considered to be definitely better tolerated than any of the other media studied.

It should be added that with only one of the compounds was there any mechanical difficulty in injection. This was encountered with Renografin, as has been reported previously by Lentino *et al.* (11). Due to the relatively high viscosity of this compound, considerably greater care was needed in handling the material, in order to prevent sticking of the syringe, than with any of the other compounds. It was found that the major cause of the difficulty was allowing the fluid to drip back from the needle along the syringe barrel when air bubbles were being evacuated. When this fault was corrected by more careful handling, no further difficulty was encountered in injection.

SUMMARY AND CONCLUSIONS

A series of 1,726 excretory urograms obtained with various media were evaluated. Neo-Iopax 50 per cent was used for 318, Urokon 50 per cent for 152, Miokon 50 per cent for 281, Hypaque 50 per cent for 345, Renografin 76 per cent for 630 cases.

The incidence of reactions, particularly nausea and vomiting and arm and shoulder pain, was definitely lower with Hypaque and Renografin than with the other compounds investigated.

Miokon afforded a slightly higher percentage of excellent pyelograms than any of the other media, though the figure was so closely approached by Hypaque and Renografin that the difference is without statistical significance. The number of satisfactory and excellent studies obtained with Neo-Iopax was significantly lower.

It is the opinion of the authors that Hypaque and Renografin are the most satisfactory media available for excretory urography when the factors both of patient tolerance and radiographic quality are considered. Truly allergic reactions and the more serious vasomotor reactions will probably occur in about the same relative frequency with all the contrast materials currently used, although this is difficult to evaluate statistically since the percentage of such reactions is exceedingly low with all of the modern urographic media.

1326 St. Antoine
Detroit 26, Mich.

REFERENCES

1. NESBIT, R. M., AND LAPIDES, J.: Preliminary Report on Urokon, a New Excretory Pyelographic Medium. J. Urol. **63**: 1109–1112, June 1950.

2. BARRY, C. N., AND ROSE, D. K.: Urokon Sodium 70 Per Cent in Excretory Urography. J. Urol. **69**: 849–855, June 1953.

3. NESBIT, R. M., AND NESBITT, T. E.: Experiences with High Concentration Urokon for Pyelography. J. Urol. **70**: 332–337, August 1953.

4. TICE, G. M.: Experience with a New Urographic Agent—Hypaque. J. Kansas M. Soc. **56**: 130–132, March 1955.

5. MOORE, T. D., AND MAYER, R. F.: Hypaque: An Improved Medium for Excretory Urography. A Preliminary Report of 210 Cases. South. M. J. **48**: 135–141, February 1955.

6. FREI, A.: Ein neues Kontrastmittel zur intravenösen Urographie (vorläufiger Bericht), Deutsche med. Wchnschr. **79**: 1636–1637, Oct. 29, 1954.

7. MAY, F., AND SCHILLER, M.: Urografin, ein neues Mittel zur Ausscheidungsurographie. Med. klin. Berl. **49**: 1403–1405, Aug. 27, 1954.

8. Monographs on Therapy, Vol. 1., No. 1, March 1956. The Squibb Institute for Medical Research.

9. NICOLAI, C. H.: Miokon: A Preliminary Clinical Report on a New Intravenous Urographic Medium. Missouri Med. **52**: 703–704, September 1955.

10. NICOLAI, C. H.: Miokon, a New Intravenous Urographic Medium. J. Urol. **75**: 758–760, April 1956.

11. LENTINO, W., ZEITEL, B. E., JACOBSON, H. G., AND POPPEL, M. H.: Intravenously Given Urographic Mediums. Comparative Study of Eight Hundred Cases. J.A.M.A. **161**: 606–609, June 16, 1956.

SUMMARIO IN INTERLINGUA

Un Evalutation Comparative Del Plus Recente Substantias De Contrasto Pro Urographia Excretori

Esseva evalutate un serie de 1.726 urogrammas excretori que habeva essite obtenite per medio de varie substantias de contrasto. Neo-Iopax a 50 pro cento habeva essite usate pro 318 de iste urogrammas; Urokon a 50 pro cento pro 152; Miokon a 50 pro cento pro 281; Hypaque a 50 pro cento pro 345; e Renografin a 76 pro cento pro 630. Le incidentia de reactiones—specialmente nausea e vomito e dolores in bracio e spatula—esseva definitemente plus basse con Hypaque e Renografin que con le altere compositos studiate.

Miokon provideva un levissimemente

plus alte procentage de excellente pyelogrammas que ullo del altere substantias, sed le cifra in question esseva si pauco supra illo attingite per Hypaque e Renografin que le differentia esseva sin signification statistic. Le numero de studios satisfactori e excellente que esseva obtenite per medio de Neo-Iopax esseva significativemente plus basse.

In le opinion del autores, Hypaque e Renografin es le plus satisfactori del substantias disponibile pro urographia excretori, quando le factores de tolerantia per le patiente e de qualitate radiographic es ambes prendite in consideration. Reactiones vermente allergic e le plus seriose reactiones vasomotori va probabilemente occurrer con equal frequentia con omne le substantias de contrasto que es currentemente in uso, sed iste aspecto del question es difficile a determinar statisticamente, proque le incidentia de tal reactiones es excessivemente basse con omne le moderne substantias urographic.

Simultaneous Roentgen Examination of the Urinary and Biliary Tracts with Duografin[1]

BURTON GARFINKEL, M.D., and NATHAN JAMES FURST, M.D., F.A.C.R.

INTRAVENOUS pyelography and oral cholecystography are fully established radiologic procedures, dating back to the 1920's. The introduction of Biligrafin in Germany in 1953 (1) and its subsequent development in the United States as Cholografin, a 20 per cent solution of the disodium salt of N,N[1] adipyl bis (3-amino-2; 4; 6 triiodobenzoic acid), opened a new era of intravenous cholecystography. This agent has been uniformly successful in demonstrating both the biliary tree and the gallbladder.

More recently, a new product for the simultaneous visualization of the renal and biliary excretory tracts has been made available. This is Duografin, a radiopaque fluid mixture containing 40 per cent Renografin for urography and 20 per cent Cholografin for cholecystography and cholangiography. Both media are present as the methylglucamine salt in aqueous solution. Duografin is supplied in packages of two ampules, each containing 20 c.c., together with two 1.0 c.c. ampules for sensitivity testing.

Duografin contains, in each cubic centimeter, 400 mg. of Renografin acid, 200 mg. of Cholografin acid, and 198 mg. of methylglucamine. Chemically, Renografin acid is 3,5-diacetylamino-2,4,6-triiodobenzoic acid; it contains 62.1 per cent of bound iodine. Cholografin acid contains 66.8 per cent bound iodine, and the solution supplied as Duografin, 38.2 per cent. This solution has a *p*H of 7.22 and a specific gravity of 1.430. Its viscosity at 20° C. is 28 centipoises (2).

INDICATIONS

The indications for the use of Duografin include all of the indications for pyelography and intravenous cholecystocholangiography. In addition, it is indicated in acute abdominal diagnostic problems, especially those pointing to the right upper abdomen, where time is an important factor in diagnosis and treatment. Duografin is also of value in routine examinations to save time and radiation exposure of the patient.

PREPARATION AND ADMINISTRATION

Appropriate preparation of the patient aids greatly in obtaining diagnostic roentgenograms. Satisfactory results have been achieved, however, in emergency cases without any preliminary measures. The routine employed at the Newark Beth Israel Hospital has included a low-fat meal the night before the examination, as well as a laxative, usually castor oil. Breakfast is withheld the following morning.

On arrival in the X-ray Department, the patient is given 1.0 c.c. of Duografin intravenously as a test of sensitivity. After half an hour, if no adverse reaction has been observed, 40 c.c. are given intravenously over a ten-minute period. Any mild allergic reaction, such as pruritus, urticaria, or gastrointestinal upset, is treated by the administration of 20 mg. of Benadryl intravenously. Benadryl and Duografin are not miscible in the same syringe.

RADIOLOGIC TECHNIC

In general, the radiological technic involves a combination of those employed for routine intravenous pyelography and for intravenous cholangiography. Before the injection of Duografin, a preliminary survey film (14 × 17 in.) of the abdomen is taken.

Five minutes after the termination of the injection, an exposure of the abdomen, with the patient supine and a 14 × 17-inch film arranged transversely to include

[1] From the Department of Radiology, Newark Beth Israel Hospital, Newark, N. J. Accepted for publication in July 1957.

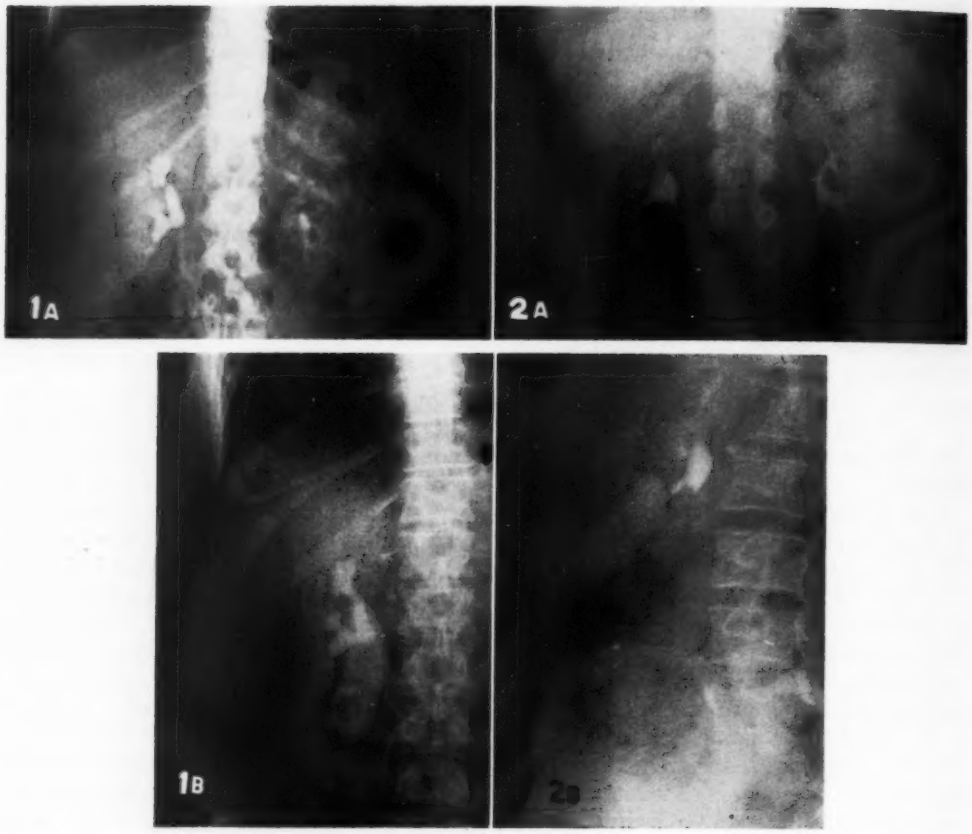


Fig. 1. Case 10. A. Exposure made five minutes after completion of injection, showing good urinary function. B. Exposure made one and a half hours after completion of injection, showing well filled gallbladder with calculus.
Fig. 2. Case 24. A. Exposure made five minutes after completion of injection: normal pyelogram. B. Exposure made one hour after completion of injection, showing well filled gallbladder with calculus.

the renal area, is made. In most cases, the renal pelves and calyces are already filled with contrast substance at this time. Subsequent exposures are made at fifteen minutes and thirty minutes, with the patient supine, on 14 × 17-inch films arranged longitudinally. This completes the pyelogram. The common bile duct and frequently the gallbladder now begin to visualize. The patient is turned into the prone position and 11 × 14-inch films centered over the gallbladder are exposed at forty-five minutes, one hour, and then every half hour until the study is completed. The obliquity of the patient's position is varied to separate the biliary structures from the urinary structures, and both from the spine. Occasionally, upright postero-anterior exposures are made, as well as postprandial films. If the gallbladder is known to be present, but does not visualize after three hours, an exposure is made twenty-four hours later. In a few of our cases, tomography was also utilized as an aid in visualizing the duct structures.

CASE MATERIAL AND RESULTS

Twenty-five patients at the Newark Beth Israel Hospital were studied with Duografin between December 1956 and May 1957. The cases were selected on the basis of the attending physician's differential diagnosis, including both urinary

and biliary diseases. On a few occasions patients suspected of having only biliary tract disease were also studied. Both ward and private hospital cases were represented, and many attending physicians were involved. This diversity of sources plus the extreme urgency of some of the cases caused a variation in our laboratory and pathological correlations with the roentgen findings.

Of the 25 patients studied, 15 were females and 10 were males. In 16 of the 25 patients the gallbladder visualized satisfactorily. Four of the remaining 9 had had previous cholecystectomies, and in 3 of these the common bile duct showed good visualization. Of the 5 patients with nonvisualization of both gallbladder and bile duct, 4 showed some pathological process in the liver or bile ducts as indicated in Table I. No diagnosis was arrived at in the last case.

TABLE I: NONVISUALIZATION OF BILIARY TRACT

Case No.	Cholecystectomy	Duct Visualization	Pathological Finding
2	No	No	Carcinomatosis of liver metastatic from pancreas
6	Yes	Yes	Status postcholecystectomy
15	Yes	Faint	Status postcholecystectomy
16	Yes	No	Possible common duct stone
20	No	No	Hodgkin's disease of nodes of porta hepatis
21	Yes	Yes	Status postcholecystectomy
22	No	No	Cholecystitis and cholelithiasis
23	No	No	None proved
25	No	No	Gangrenous cholecystitis and cholelithiasis

All of the 25 patients studied showed good urinary tract visualization. In 3 patients, only one kidney was clearly demonstrated. In these 3 patients, pathological processes on the nonvisualized side were found as shown in Table II.

None of the patients in this study exhibited any severe reactions to the Duografin. In a few patients, there were mild nausea and some retching, which responded immediately to 20 mg. of Benadryl given intravenously. No instance of pruritus, urticaria, or anaphylaxis was encountered in this small group.

TABLE II: NONVISUALIZATION OF URINARY TRACT

Case No.	Non or Poorly Visualized Side	Pathological Findings
6	Left	Nephrectomy previously performed
8	Right	None proved
9	Right	Right ureteral calculus

The use of Duografin is contraindicated in patients exhibiting sensitivity to the test dose, and in those with severe impairment of renal and liver function. Caution should be observed in the presence of extreme debilitation, and satisfactory visualization of the kidneys and ureters should not be anticipated in patients with anuria or uremia.

SUMMARY AND CONCLUSION

Duografin, a combination contrast medium for the simultaneous performance of urography and cholecystocholangiography was administered to 25 patients without serious consequence. Most of the patients showed excellent visualization of both tracts. In almost all patients where nonvisualization of one or the other tract was encountered, pathological impairment of function was demonstrated.

The use of Duografin eliminates the necessity of using two separate intravenous injections. It is of special value in acute cases, where time is an important factor in making a definitive diagnosis. It also saves time and avoids the necessity of two separate preparations for routine radiological studies.

U. S. Army Hospital
Fort Jay, N. Y.

REFERENCES

1. FROMMHOLD, W.: Ein neuartiges Kontrastmittel für die intravenöse Cholezystographie. Fortschr. a. d. Geb. d. Röntgenstrahlen **79:** 283–291, September 1953.

2. LUND, M. H.: Technical Information. New Brunswick, N. J., Squibb Institute for Medical Research.

(Pro le summario in interlingua, vider le pagina sequente)

SUMMARIO IN INTERLINGUA

Le Roentgeno-Examine Simultanee Del Vias Urinari E Biliari Per Medio De Duografin

Duografin, un combination de substantias de contrasto pro le execution simultanee de urographia e cholecystocholangiographia, esseva administrate sin serie consequentias a 25 patientes. In le majoritate del patientes, excellente grados de visualisation del duo vias esseva obtenite. In quasi omne le patientes in qui non-visualisation del un o del altere via esseva incontrate, le presentia de un dysfunction pathologic esseva demonstrate.

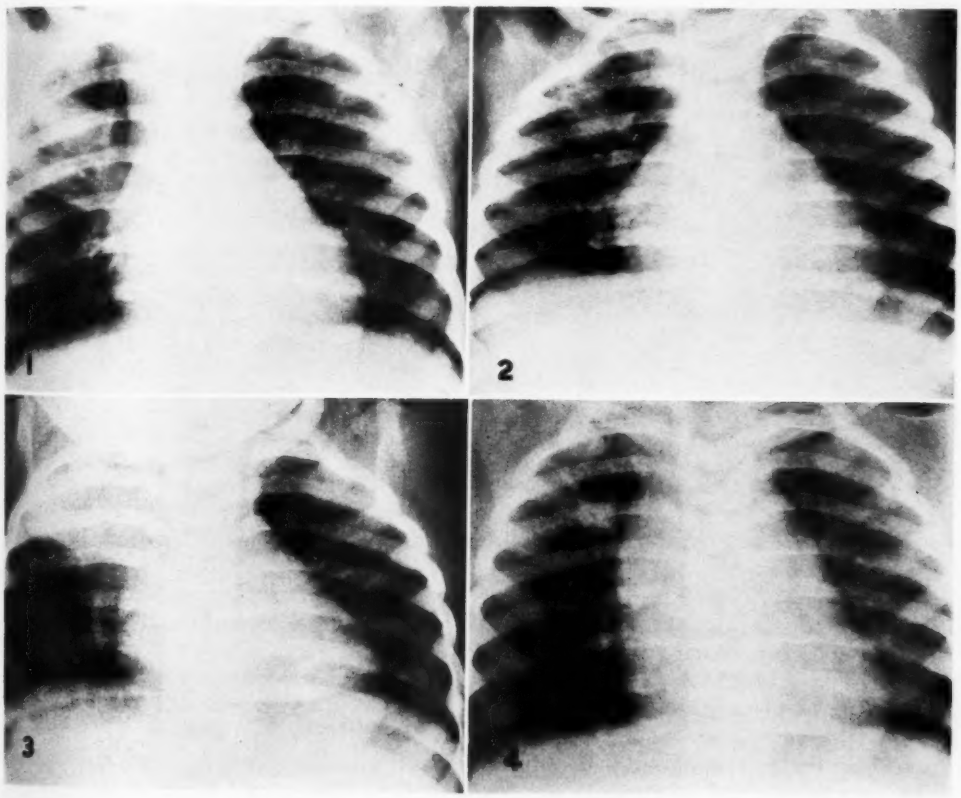
Le uso de Duografin elimina le necessitate de duo separate injectiones intravenose. Illo es de valor special in casos acute in que promptitude es un factor urgente in establir le diagnose definitive. Illo etiam effectua un economia de tempore e evita le necessitate de duo preparationes separate pro routinari studios radiologic.

Roentgen Manifestations of Pulmonary Tuberculosis Under Drug Therapy[1]

LAWRENCE A. DAVIS, M.D.

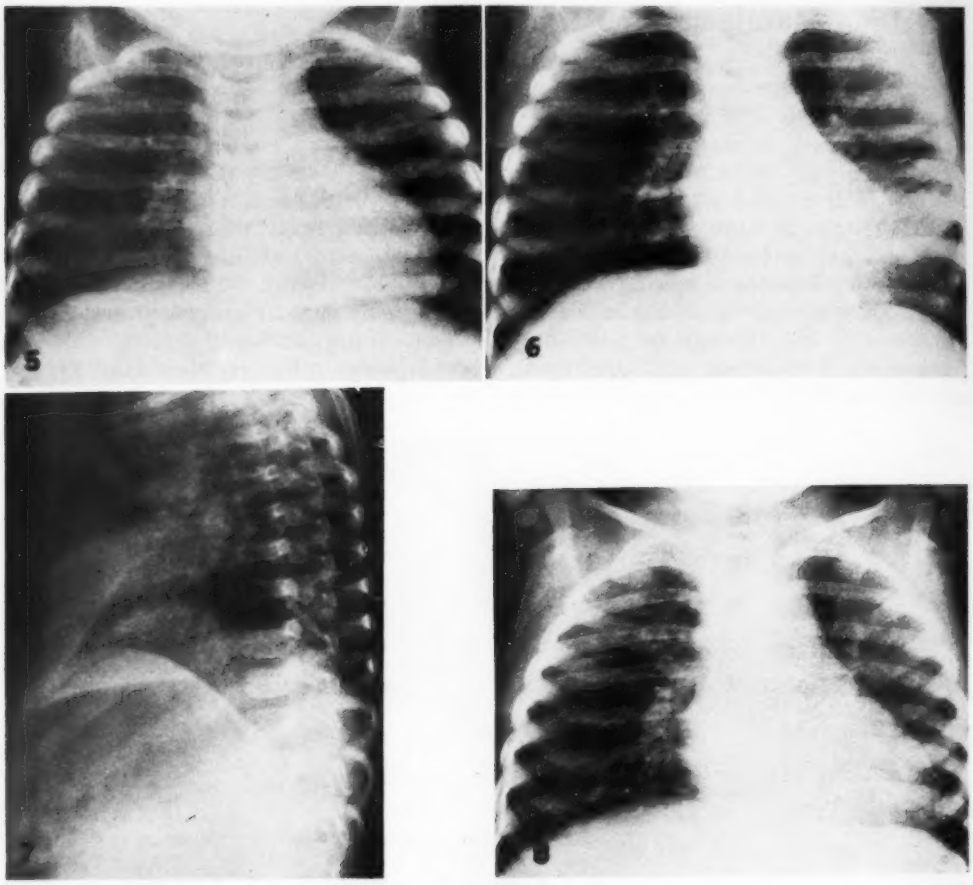
TUBERCULOSIS in children has always presented a different picture than in adults. The importance of the hilar adenopathy is well understood, as is its effect on adjacent bronchi ("epituberculosis") (1–4). Since the advent of the antimicrobial drugs in the therapy of pulmonary tuberculosis (isonicotinic acid hydrazide, para-aminosalicylic acid, and Streptomycin), further evaluation of the changing roentgen picture is necessary.

It appears likely that the miliary infiltrates are attacked directly by the drugs and resolve rapidly. This process can be followed by serial roentgenograms. Conversely, it appears likely that the enlarged lymph nodes, whatever their etiology, are not particularly affected and can swell



Figs. 1–4. Case I.
Fig. 1. Initial film showing primary tuberculous complex. March 11, 1955.
Fig. 2. Patient afebrile; clinically improved. Primary complex resolving. April 4, 1955.
Fig. 3. Patient afebrile. Marked right upper lobe involvement. May 9, 1955.
Fig. 4. Patient clinically well. Right upper lobe infiltrate resolving. The widened mediastinum is in part caused by the thymus gland as well as by enlarged nodes. Nov. 22, 1956.

[1] From the Departments of Radiology, the Children's Hospital and the University of Louisville Medical School, Louisville, Ky. Presented as an exhibit at the Forty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2–7, 1956. Accepted for publication in August 1957.



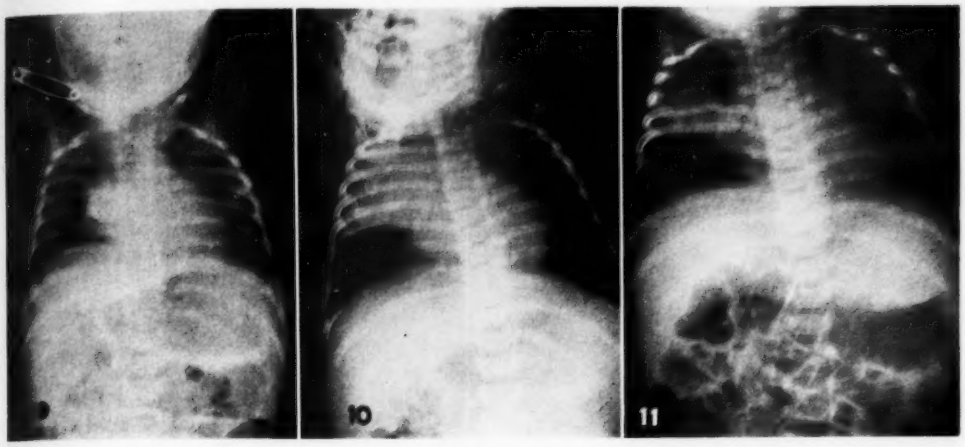
Figs. 5–8. Case II.
Fig. 5. Initial film: classical miliary tuberculosis. Nov. 22, 1954.
Fig. 6. Patient asymptomatic. Miliary lesions resolving. Involvement of lingular segment. Jan. 18, 1955.
Fig. 7. Lateral view. Jan. 18, 1955.
Fig. 8. Patient afebrile. Miliary infiltrates gone. Resolution of lingular infiltrate. Feb. 8, 1955.

and continue their pressure effect in the face of adequate drug therapy. Thus, there may occur, during the course of treatment in a child who has pulmonary tuberculosis, a disparity between the clinical and roentgen pictures. Surprising and distressing findings may suddenly appear in the roentgenograms of patients who are considered to be asymptomatic and progressing satisfactorily clinically. These changes may consist of large areas of segmental infiltrate or collapse, or patches of obstructive emphysema. Frequently, during the course of regression of miliary lesions, a segmental or lobar collapse appears, apparently unrelated to the progressive improvement in the clinical picture.

These changes are without influence on the clinical treatment and will usually resolve if the same regimen is continued. Failure to observe this consideration may lead to premature surgical intervention. Choremis *et al* (5) associated febrile episodes with the worsening of the roentgen picture, but there were no other clinical symptoms.

CASE HISTORIES

CASE I: M. T., a 19-month-old white girl, who had close family contact with tuberculosis, was ad-



Figs. 9–11. Case III.
Fig. 9. Initial film, showing primary complex. Feb. 24, 1955.
Fig. 10. Patient asymptomatic. Consolidation of entire right upper lobe. March 28, 1955.
Fig. 11. Clearing of right upper lobe. May 6, 1955.

mitted with clinical and laboratory evidence of tuberculous meningitis. Combined therapy was started immediately upon admission (para-aminosalicylic acid, 2 gm. per day; isonicotinic acid hydrazide, 80 mg. per day; Streptomycin, 2 gm. per day). The first examination showed a primary tuberculous complex with right upper lobe infiltrate and adjacent hilar adenopathy (Fig. 1). On April 4, 1955 (Fig. 2), the patient was afebrile, had gained three pounds since admission, and was clinically quite improved. A film at this time showed regression of the primary complex. However, on May 9 (Fig. 3), though there was still no fever or other clinical symptoms, the films showed a marked involvement of the right upper lobe. While the patient continued to improve clinically and to gain weight, the upper lobe lesion gradually resolved (Fig. 4). Streptomycin was discontinued at this time. On Oct. 17, 1956, the child was seen as an outpatient, and only a small scar remained in the right upper lobe area. Isonicotinic acid hydrazide had been continued during the interval.

CASE II: S. L., a 16-month-old white girl, was referred to the Children's Hospital for diagnosis and treatment after a four-week illness characterized by fever without response to penicillin or sulfonamide therapy. The diagnosis of miliary tuberculosis was made from the history (grandfather with active tuberculosis), the positive tuberculin test, and the roentgen examination. The film of Nov. 22, 1954 (Fig. 5), showed classical miliary infiltrates spread evenly throughout both lungs. Combined therapy was instituted: Streptomycin, 1.0 gm. per day; para-aminosalicylic acid, 1.0 gm. per day; isonicotinic acid hydrazide, 75 mg. per day. The infiltrates gradually resolved, and on Jan. 18, 1955

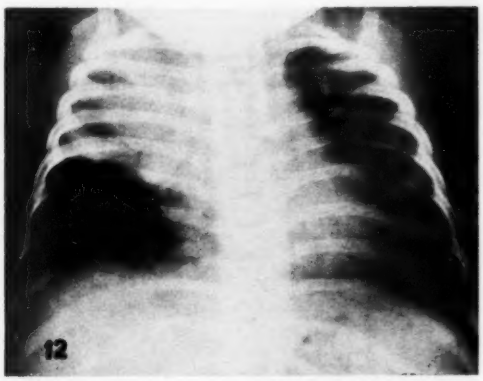
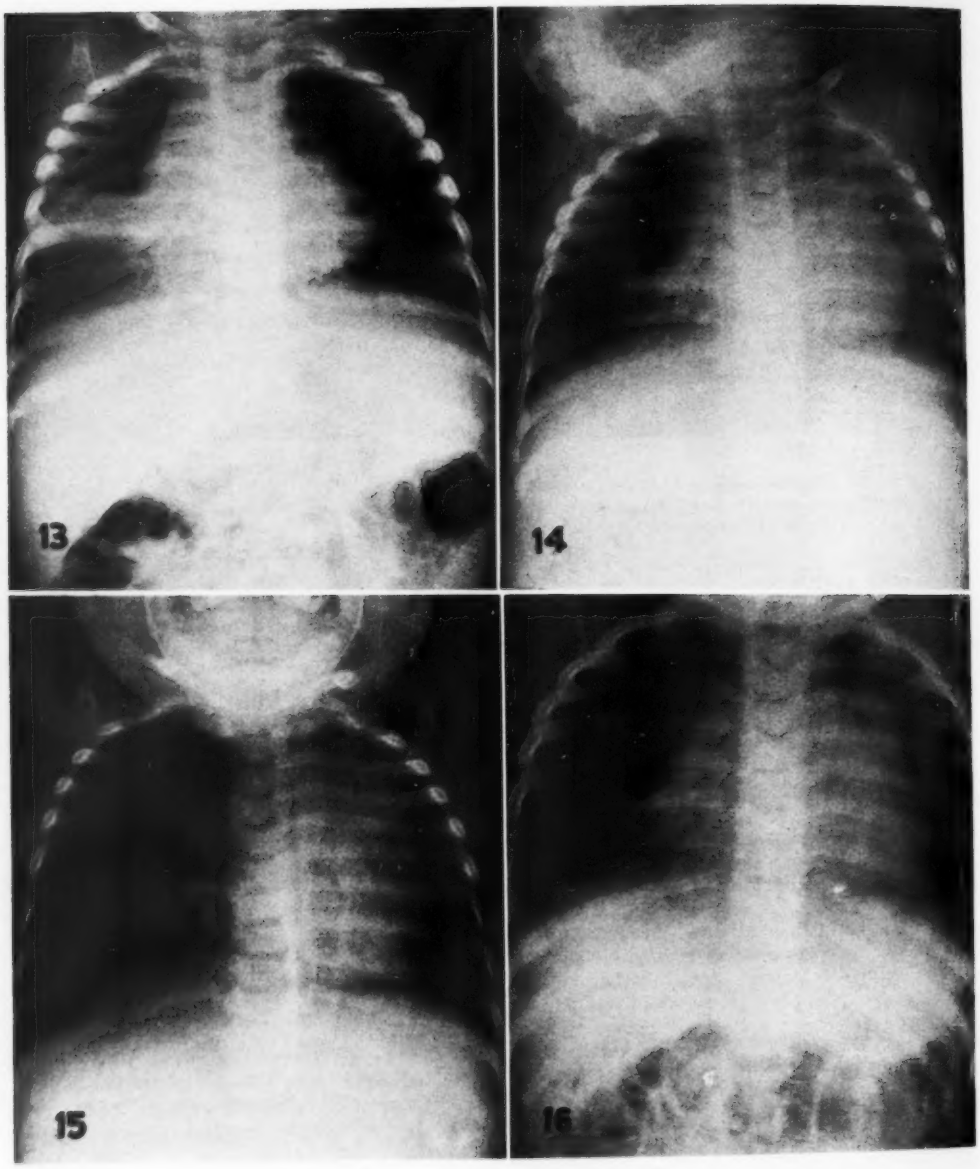


Fig. 12. Case III. Patient asymptomatic. Reinvolvement of right upper lobe. May 13, 1955.

(Figs. 6 and 7), though the patient was asymptomatic and afebrile, involvement of the lingular segment of the left upper lobe was noted. On Feb. 8 (Fig. 8), the patient was clinically well, the miliary infiltrates had completely resolved, and the lingular segment was almost clear.

CASE III: R. S., a 5-month-old white boy, was admitted for treatment of primary tuberculosis, after the institution of combined therapy elsewhere one month earlier. He was in critical condition, with malnutrition and dehydration. The initial film, Feb. 24, 1955 (Fig. 9), showed a primary complex on the right. Combined therapy was continued (Streptomycin, 40 mg./kilo, isonicotinic acid hydrazide, 8 mg./kilo, and para-aminosalicylic acid, 200 mg./kilo). On March 7, the patient was afebrile and was gaining weight, but the lymph node



Figs. 13–16. Case IV.

Fig. 13. Four-pound weight gain. Some wheezing. Involvement of right middle lobe. Nov. 19, 1955.
Fig. 14. Partial resolution of middle lobe infiltrate. Dec. 22, 1955.
Fig. 15. Wheezing without distress. Marked emphysema of right lung. Jan. 16, 1956.
Fig. 16. Patient asymptomatic. Check valve emphysema has resolved. Residual middle lobe infiltrate remains. Nov. 10, 1956.

lesion on the right had increased in size. On March 28, though the weight was 3 lb., 3 oz., over the admission weight, the entire right upper lobe was consolidated (Fig. 10). The child continued to gain weight and was asymptomatic. The upper lobe gradually cleared, so that only a small portion was involved, as noted on the film of May 6 (Fig. 11). Seven days later, however, May 13, the whole upper lobe was again consolidated (Fig. 12). The consolidation gradually resolved, and on Sept. 1,

1955, when the patient was last seen, only a small residual infiltrate was present in the upper lobe and adjacent lymph node area. The combined therapy was halted in this period.

CASE IV: C. M., a 6-month-old Negro male, was admitted after a diagnosis of primary tuberculosis following a positive reaction to a tuberculin skin test during an investigation for poor weight gain. The initial film was compatible with early, primary pulmonary tuberculosis. At this time, therapy consisted of an unknown drug supplied by the Public Health Service as part of their research into the effects of isonicotinic acid hydrazide on childhood tuberculosis. Four months later, Nov. 19, 1955, after a four-pound weight gain, radiographs showed involvement of the right middle lobe (Fig. 13). At this time the patient had some wheezing, and the cough recurred, but he was active and happy. The wheezing continued, though the patient was still gaining weight. The middle lobe infiltrate had resolved somewhat by Dec. 22 (Fig. 14). The wheezing continued, and a check-valve obstruction occurred, involving the entire right lung, with marked emphysema on that side (Fig. 15). Because of the nature of the disease, the patient was put on combined therapy (isonicotinic acid hydrazide, 80 mg. per day, para-aminosalicylic acid, 2 grams per day, and Streptomycin, 0.5 gram per day) and the unknown drug was discontinued. Following bronchoscopy, the emphysema resolved. It recurred several days later, but without change in the clinical symptoms. With no further specific therapy the emphysema gradually subsided, and the middle lobe infiltrate resolved. On the last examination only a small scar remained in the middle lobe (Fig. 16).

SUMMARY

During the present antimicrobial therapy program for childhood pulmonary tuberculosis, there may be a marked disparity between the roentgen and clinical pictures. In spite of clinical improvement, the roentgenogram may show large areas of density, probably secondary to adenopathy and lobar collapse. Most of these changes will disappear under continuance of the original therapy.

NOTE: Dr. William C. Adams, Department of Pediatrics, was of great aid in the assembling and interpretation of the above facts. My sincere appreciation is expressed to him.

226 E. Chestnut St.
Louisville, Ky.

REFERENCES

1. LINCOLN, E. M.: Indications for Treatment of Tuberculosis in Children. Am J. Surg. **89**: 645–648, March 1955.
2. RIBIN, M.: The Role of Resectio n for Pulmonary Tuberculosis in Children and Adolescents. Am. J. Surg. **89**: 649–662, March 1955.
3. LINCOLN, E. M.: Effect of Antimicrobial Therapy on the Prognosis of Primary Tuberculosis in Children. Am. Rev. Tube rc. **69**: 682–688, May 1954.
4. CHAPMAN, J. S.: Tuberculosis in Infants and Children. A Review. Am. Rev. Tuberc. **73**: 422–433, March 1956.
5. CHOREMIS, C. B., PADIATELLIS, C., ZOUMBOULAKIS, D., AND YANNAKOS, D.: Transitory Exacerbation of Fever and Roentgenographic Findings During Treatment of Tuberculosis in Children. Am. Rev. Tuberc. **72**: 527–536, October 1955.

SUMMARIO IN INTERLINGUA

Manifestationes Roentgenographic De Tuberculose Pulmonar Sub Therapia A Drogas

Durante le presente programma de therapia antimicrobial pro tuberculose pulmonar in juveniles, il pote occurrer marcate grados de disparitate inter le tableau roentgenographic e le tableau clinic. In despecto de melioration clinic, il pote occurrer que le roentgenogramma monstra extense areas de densitate, probabilemente secundari a adenopathia e collapso lobar. Le majoritate de iste alterationes dispare in le curso del continuation del therapia original.

Use of the Eyes in X-Ray Diagnosis[1]

FRANK A. RIEBEL, M.D.

HAVE YOU ever missed a perfectly obvious rib fracture? Or overlooked an obvious lung infiltration? If so, you have known real discomfort—the inability to explain such an oversight to your colleagues, for it is far more inexplicable than an error in diagnosing what you actually saw. Let us try to explain why these things happen, and attempt to justify systems which will make these accidents less likely. For we must have systems. Children who take a standard intelligence test (Terman) are given this problem: "You have lost a ball in this round field. Here is the gate. With your pencil show me how you would look for it." With this test the child of eight years will show some system, while the one of twelve is expected to sketch a regular plan.

If we are to develop a routine for scanning films, what approach shall we use? Two systems present themselves: the anatomical and the psychological. In some situations there is no problem. In a retrograde pyelogram one could scarcely do other than look at the kidneys and then the ureters and bladder. In upper gastrointestinal films, one naturally follows with the eye the course of the barium. Elsewhere, however, the body is not so obliging. Can the psychology of seeing help us here?

SIZE OF THE VISUAL FIELD

The eyes are capable of optically registering a fairly sharp image of most of a 14 × 17-inch film at one fixation, provided the viewer does not stand too close. But whether or not that view is psychically registered is a different matter. We are so conditioned to fixing our attention that only the center of the field may reach our consciousness. Yet the ability to comprehend the whole field can be cultivated. During World War II, speed in aircraft recognition became so important that men were trained to identify objects in fractional exposures, down to 1/100 of a second, by being taught to perceive larger visual fields. Cannot the same thing be done in radiology?

We believe that unconsciously this skill is developed in chest film reading. This is easily understandable in the case of miniature films, where the whole picture is seen in a small field. But even large films (14 × 17 in.) can usually be recognized as positive or negative by the expert about as fast as they can be put up. He has expanded his visual fields to comprehend all he sees in a postero-anterior projection. He does not find this so easy in the case of lateral or oblique views as a rule, because he has not the thousands of previous experiences from which to draw. Nor can he do it on a heavily exposed film, which requires more minute inspection.

But few men would aver that they can read films of all sorts at a glance. What is their system in scanning? Questioning radiologists has not been helpful: some simply say they look at what interests them; others report their own private methods, which they admit are not particularly rational. Let us, then, take a fresh start with what facts are available.

THE PSYCHOLOGY OF SEEING

In behalf of advertising, the psychologists (1) have recorded certain observations which may have some bearing on film reading. Some of these are:

1. The first fixation falls to the left and above the middle of the page. This is a very strong tendency, but modifiable by subject matter.
2. Sixty-six per cent of the time is spent

[1] From the Department of Radiology, University Hospital, Ohio State University, Columbus, Ohio. Accepted for publication in July 1957.

on the left half of the page; 34 per cent on the right.

3. Sixty-one per cent is spent on the upper half, 39 per cent on the lower.

4. More than four fixations in the same direction are unusual in scanning. In the first exploration there is a strong tendency to move clockwise.

5. Horizontal movements are favored over the vertical. "To require the subject to make an excessive number of eye movement vertically places greater demands on the physical and nervous energy and introduces a type of annoyance which is minimized when the eye moves horizontally."

6. On a two-page spread 57 per cent of the time is spent on inside positions, 43 per cent on the outside.

7. One cannot easily follow a straight line for long. Thus a typewritten page with lines 6 or 7 inches long is about right. But neither can one efficiently read very short lines, for there the valuable peripheral vision is lost.

All of the above is well documented for reading the printed word. To paraphrase it for the reading of films has its risks. It may, however, give us suggestions on developing a system.

The Skull: We have learned that we look first to the left of and above the center. The next fixation is usually up and to the left, followed by a clockwise inspection (1). What could be more natural, then, than to examine the calvarium in a clockwise direction, bone by bone? This pattern is followed whether or not the face is to the left or right; that is, always clockwise.

One could make the circuit a larger and more irregular one to include the facial bones, but it is a bit more efficient to make a second smaller circle for these, the principal reason being that the area is darker, perhaps requiring special lighting, and will surely be scanned at a slower rate because of dimness and the complexity of shadows. The same two circles are scanned in viewing an anteroposterior projection.

The Hand: The film of the hand is customarily placed on the view-box with the fingers up. We submit that this is wrong psychologically. If it is placed on the side, one can view it from left to right in successive tiers, with the least eye strain, missing nothing, and getting, as a bonus, a different idea of carpal function. But it may be that habit plus deference to confreres has kept us in the old pattern. In that event, it is an easy ocular task to examine the phalanges in successive arcs, from left to right, since densities are graduated as one comes toward the wrist. If the eyes do not span all of a metacarpal at a single fixation, the pattern may have to be supplemented by short vertical runs. The carpals are inspected—a clockwise pattern is convenient—and then the radius and ulna.

An alternative plan is to scan from the tip of each digit down through each metacarpal, starting with the one on the left, and then the wrist area as before. Some observers, however, may find the long vertical type of scanning tiresome, with the eyes wandering away unsystematically.

Firm determination is required to examine a full 17-inch vertical strip on, let us say, a femoral shaft or other long bone, for ocular resistance makes us want to stop short. On a foot film, however, and especially on a semilateral projection, one views every bit of bone most easily when the film is so placed that one looks from left to right along each row of bones from above down.

The Pelvis: Let us apply convenient optical principles here, *working from left to right, from above downward, using clockwise circles when convenient, and comparing like with like.* After a quick glance around, we look at the right iliac bone minutely in a roughly clockwise fashion; next around the left ilium; around the right and then the left obturator foramen; then the sacrum and coccyx. Quick glances at the lower lumbar spine, upper femurs, and soft tissues complete the task.

The Flat Plate of the Abdomen: Paulson

(2) quotes the dictum that "one sees what one looks for," and states that the abdominal flat plate cannot with profit be scanned on one round; rather one must go around once for bones, another time for soft tissues, again for gas pattern, and still again for calcifications. In other words, the eyes and mind must be adjusted for various levels of density.

Ribs: A search for rib fractures is the most trying visual job in radiology, because of the fine changes sought, the extremes in density on most films, the awkward curves to be followed, and the readiness with which one loses his place. The writer examines the right posterior ribs from the midline laterally, one side at a time, marking his place at the midline, by pointing, as he moves downward. He then scans the lateral and anterior portions of the ribs separately and repeats the pattern for the left side.

These are enough examples to suggest that each radiologist should expand his visual fields by constant practice; in viewing films he should take a hasty look around and then follow a plan in viewing specific parts lest he favor some areas of the film over others. In making this plan, he should favor reading from left to right, starting from the top, when anatomy conforms, or in clockwise circles, or in vertical or even oblique sweeps when necessary, in the knowledge that these latter are the tiring patterns, where the eye may not follow all the way.

In these suggestions there is no thought of blind ritual. It would be senseless not to view at once the startling and not to allow reason full play; but eventually the whole film should be examined by some pattern.

VISUAL ACUITY VERSUS BRIGHTNESS AND CONTRAST

Our visual failures cannot be blamed on the eyes as optical instruments, their resolving power (3) being 1 minute of arc (*i.e.*, the ability to distinguish two *points* which at 10 inches focal distance are 1/13 mm. apart). *Lines* can be distinguished when separated by 1 second of arc. By comparison an intensifying screen will resolve about 10 lines to the millimeter, with nonscreen technics, of course, giving finer detail. Our eyes, then, are more than adequate for black on white with good illumination. But how are they with lower contrast and illumination?

Weston (4) found that accuracy is practically independent of contrast and illumination for fairly large objects (6 minutes of arc) and in the middle of the scales for brightness and contrast. This lends some support to those who believe that high-voltage radiography is better. We are better off with a long series of grays, for high contrast adds little to visual acuity in the middle ranges. But it loses much for us in too light or too dark areas—especially the latter, which we may carelessly not even inspect.

There is, however, an exception to this. When we get down to small sizes (1 minute of arc), visual acuity becomes sharply dependent on brightness and contrast (4). In looking for miliary lesions, therefore, it might be well to abandon high-voltage technic in favor of extreme contrast.

It is interesting that nonscreen film gives the finest detail, but its utility is limited because it gives low contrast with ordinary densities and illumination. It has also another characteristic: contrast continues to rise with increased densities, whereas with screen film it falls off (5). Optimal contrast is achieved, therefore, not only by keeping voltages low, but by producing a dark film to be used with brilliant lighting, for (3) "acuity of vision rises arithmetically as illumination rises geometrically."

Fuzziness of outline lessens the power to identify. Therefore, according to Newell, increased viewing distance in some situations may increase visual acuity. This explains why some lesions can be seen as dependably on miniature as on full-sized films (6).

BEHAVIOR AT THE ILLUMINATOR

The facilitation of visual tasks depends upon whatever can be done to make more conspicuous the features of the work-object, so that in Stout's picturesque words "each of them emerges from its environment like an island from the sea" (7).

The first *sine qua non* of film reading is attention. "Inattention makes us virtually blind." As we watch our colleagues dictating while technicians rush in with odd questions, and visiting doctors drop in for information or gossip, it is amazing to us that their accuracy is what it is. The radiologist has the same right to concentration as the surgeon. He should demand it; failing that, he should take refuge where he can find it.

For maximum acuity, all illuminators not in use should be switched out. This is not a mere matter of comfort; light bouncing about inside the eyeball diminishes vision sharply. Thus acuity has been shown to drop off markedly even when light from lateral fields is focused on the blind spot, showing that the factor is ocular, not cerebral (8).

It is unfortunate that our illuminators do not have shutters with which to view smaller films. A mask is useful here. This may be devised by simply taking a 14 × 17-inch film, covering part of it with lead, and exposing to x-rays. The piece of lead, which may conveniently be 8 × 10 inches, is placed at one end of the film, so that the clips will hold the smaller film. This will make a nice mask to put on the illuminator as needed. You often see a radiologist pull a small film off an illuminator and bring it close to his eyes. He never does that with a 14 × 17-inch film but gets closer to it, instead. His action with the small film gives him the masking desired.

We radiologists have been mighty docile about the illuminators delivered to us, by the way, with no variation possible in the intensity. Low-cost view boxes which could produce light both well above and well below the average brightness should certainly be within the abilities of our manufacturers.

FLUOROSCOPY—DARK ADAPTATION

Red goggles can never produce the dark-adapted eye, but adaptation is more precipitate after the use of red goggles. No more fundamental error can be made in fluoroscopy than to ignore this principle. On the average *four minutes* are required in complete darkness after red goggles have been worn for twenty minutes before the eyes are ready to view thick parts. After the first patient has been fluoroscoped, and red goggles are readjusted for exposure to ordinary illumination, succeeding patients can be examined after one minute of adaptation, providing strong light sources are avoided (9). When adaptation is complete, the eye has a sensitivity approaching that of the Geiger counter, for as few as 8 or 9 photons can be seen (10).

The Foot Switch: Storch (11) advises that short intermittent exposures be used, to allow the eye to accommodate between times. This strikes us as being questionable on two counts. The eye does its best with available light; that is what adaptation is. This has been confirmed by fluoroscoping with an adaptometer (9). If one starts fluoroscopy without full adaptation, and then checks quantitatively during the procedure, he finds that the adaptation has proceeded nicely.

The second error in using short bursts is that of failure to appreciate that at low brightness levels *vision is cumulative.* That is, one will not see the full stimulus for about one-fifth of a second (Duke-Elder). Probably Storch in advising intermittent exposures was not thinking of the one- to two-second bursts of fluoroscopy that the tyro often indulges in.

A particularly pernicious invention is the wiring of the red light so that it automatically alternates, on and off, with the x-ray. The following data show the handicap imposed by this system on the viewer.

An adaptometer developed by us (12)

had a shutter mounted on it. Five phosphors in the adaptometer have the following brightnesses:

Disk 1	0.060 microlambert
Disk 2	0.025 microlambert
Disk 3	0.0105 microlambert
Disk 4	0.0048 microlambert
Disk 5	0.0026 microlambert

Five minutes of dark adaptation are required by the average subject to see Disk 1, whereas Disk 5 can be seen only with virtually complete adaptation (thirteen minutes in darkness).

These disks became visible to two subjects with the following exposure at 30 inches.

	Subject V	Subject F
Disk 1	1/100 sec.	1/100 sec.
Disk 2	1/100 sec.	1/100 sec.
Disk 3	1/15 sec.	1/25 sec.
Disk 4	1/8 sec.	1/5 sec.
Disk 5	1/3 sec.	1/2 sec.

The experiment was then repeated with a 7.5-watt red bulb illuminating the room up to the moment of disk exposure. The red light was 10 feet from the subject and to the right.

	Subject V	Subject F
Disk 1	1/25 sec.	1/10 sec.
Disk 2	1/12 sec.	1/2 sec.
Disk 3	1/5 sec.	1/2 sec.
Disk 4	1.8 sec.	1 sec.
Disk 5	2.9 sec.	3.3 sec.

No great precision is claimed for these data, but they indicate that full fluoroscopic densities are not built up for about three seconds after the red light is turned off.

DESTRUCTION OF DARK ADAPTATION

Frequently the radiologist is importuned to look at films between fluoroscopic sessions. If he does so, his dark adaptation is lost quickly (13), for "light adaptation develops extremely rapidly, sensitivity being enormously reduced in twenty seconds; there is a gradual fall for two or three minutes, after which the process proceeds very slowly, until a level is reached in a little over half an hour."

Lifting the goggles and looking with one eye is only a partial solution, for it has been shown that toward the thresholds of vision one is more likely to see an event with two eyes than one. One returns to fluoroscopy, therefore, under a handicap. Russian experimenters have tried to solve this problem for their aviators by cutting a window into red goggles so they can get a peek at charts. Comparably, Silverman and Cohen (16) have described goggles with a slit lens for fluoroscopy.

Since one loses considerable dark adaptation by looking at films even through red goggles—and even then loses the delicate gradations of densities—a radiologist is justified in courteously declining to view films when he cannot give his best.

PERIPHERAL VISION

Everyone knows by now that a better fluoroscopic image is appreciated by looking at one spot and giving his attention to another. This is not always done for several reasons. First, it is a difficult thing to do routinely. Second, it is of no great value if adaptation is poor, for complete cone adaptation is achieved first; so the principle is only really effective when dark adaptation is complete or nearly so. Finally, few have bothered to learn just where peripheral vision is best. A good rule of thumb is that at 10 inches focal distance you see very well about 1 inch aside from the area focused on.

Sensitivity rises rapidly toward the periphery, so that at 4° out it is 30-fold over what it is at 1.2° (14). Beyond that point, sensitivity rises very slowly, and eventually acuity begins to drop off. To give oneself a working field of vision one may center on 6° out, which is about 1 inch at 10 inches focal distance.

Using peripheral vision is no great trick —it is the natural thing—when the fluoroscopic shutters are open wide, as for a preliminary chest survey. When they are closed down, it is against instinct, for one wants to look at the center of the illuminated area. Only practice and determination will overcome this, although

in some situations it is not too difficult. Thus, if the shadow of the colon is 2 to 4 inches across, one merely *focuses* on the center of the colonic lumen and *considers* the walls with the most sensitive part of the retina.

MOTION

One must abandon peripheral vision to observe rapidly moving objects (14). This is because perception of motion rests partly on the kinesthetic impulses from the extraocular muscles; and one does not follow objects with peripheral vision. We are speaking here of such motion as that of the heart, or the barium-filled upper esophagus. But there is another kind of motion —as of the train in a distant landscape— which one does not see directly. Rather one concludes that the train is moving because its relationships with stationary objects change. Gastric peristalsis is such an example, and here we can best use peripheral vision to take advantage of the eye's sensitivity.

In studying motion, one must either leave the shutters wide enough to preserve landmarks or use the shutter margins themselves as reference points, for (15) "the minimal angular velocity which is directly appreciable as movement by the fovea centralis is 1 to 2 minutes of arc per second when stationary objects are also present; but in their absence the liminal value is raised to 10 times."

In studying slow motion, as we have already mentioned, comparison with landmarks is absolutely essential.

SUMMARY

1. Films or screen reading is the harmonious work of eyes and mind, the simultaneous perusal of subject matter and our mental catalogues of knowledge.

Leaving to others the greater problem of subject matter, we have tried here to record knowledge of the human eye which is useful if the radiologist is to develop a system of film scanning.

2. The efficiency of the first quick survey of a film is enhanced if the operator by practice or formal training expands his visual fields to comprehend more territory at a glance, or on successive fixations. After that, each type of film is a more or less set problem, which may be approached (1) along an anatomical system, or (2) by systems based on psychological knowledge, such as the favoring of horizontal or clockwise scanning over other patterns, or (3) repeatedly, on levels of film densities. Any system must be guarded so as to scan all, and not slight some, film areas.

3. The trend away from high-contrast films is justified (high-voltage technics). There is a generally conceded exception to this trend—where the substances to be differentiated give about the same film densities, as in gallstones and their surroundings. Not so well recognized is the need for high contrast to see very small lesions.

4. Deportment at the illuminators with a view to maintaining attention and efficient work is discussed.

5. Too great a reliance on red goggles, interference by the red light and incorrect use of the foot switch cut down one's potential in fluoroscopy. Peripheral vision should be used habitually (excepting only the study of rapid motion) and will contribute much to what can be seen.

15 W. Goodale St.
Columbus 8, Ohio

REFERENCES

1. BRANDT, H. F.: The Psychology of Seeing. New York, Philosophical Library, Inc., 1945.
2. PAULSON, E. C.: Value of the Flat Plate (X-Ray) in Diagnosis of Acute Abdominal Conditions. Minnesota Med. **35**: 870–871, September 1952.
3. WESTON, H. C.: Sight, Light and Efficiency. London, H. K. Lewis & Co., 1949.
4. WESTON, H. C.: The Relation Between Illumination and Efficiency—The Effect of Brightness Contrast. Medical Research Council, Industrial Health Research Board Report No. 187. London, His Majesty's Stationery Office, 1945.
5. The Sensitometric Characteristics of Industrial X-ray Films. Rochester, N. Y., Eastman Kodak Co., Appendix 1, p. 91.
6. NEWELL, R. R., AND GARNEAU, R.: Threshold Visibility of Pulmonary Shadows. Radiology **56**: 409–414, March 1951.
7. WESTON, H. C. (3): p. 114.
8. DUKE-ELDER, W. S.: Text-Book of Ophthalmology. Vol. I. St. Louis, Mo., C. V. Mosby Co., 1933, p. 903.
9. RIEBEL, F. A.: Efficiency of Red Goggles. Am. J. Roentgenol. **70**: 827–830, November 1953.

10. CHAMBERLAIN, W. E.: Fluoroscopes and Fluoroscopy. Radiology **38**: 383–413, April 1942.
11. STORCH, C. B.: Fundamentals of Clinical Fluoroscopy with Essentials of Roentgen Interpretation. New York, Grune & Stratton, 1951, p. 9.
12. RIEBEL, F. A., AND CARROLL, C. C.: Adaptometer for Preparation for Fluoroscopy. Radiology **57**: 882–883, December 1951.
13. DUKE-ELDER (8): p. 959.
14. SOUTHALL, J. P. C.: Introduction to Physiological Optics. New York and London, Oxford University Press, 1937, p. 268.
15. DUKE-ELDER (8): pp. 1075–76.
16. SILVERMAN, F. N., AND COHEN, J.: Dark Adaptation with Limited Light and Color Vision. Radiology **68**: 733–73, May 1957.

SUMMARIO IN INTERLINGUA

Le Uso Del Oculos In Le Diagnose A Radios X

Iste articulo presenta certe suggestiones practic pro le scrutinio de roentgenogrammas e pro le observation fluoroscopic.

Le efficacia del prime rapide inspection de un roentgenogramma es augmentate per un expansion del campo visual, lo que pote esser effectuate per un practica constante. Post le prime e rapide vista del roentgenogramma, le radiologo deberea sequer un plano in le scrutinio de partes specific. Ille deberea preferer un lectura ab le sinistra verso le dextera, comenciante in alto (si le anatomia lo permitte). Ille pote leger in un circulo dextrorse o per progression vertical o mesmo oblique—sin oblidar que iste ultime configurationes es fatigante de maniera que le oculo non succede in omne casos a sequer usque al fin.

Technicas a alte voltage, resultante in alte contrastos, es sin avantage in le studio de satis extense lesiones, sed illos pote esser utile in examinar lesiones milari. Contrastos optimal es effectuate non solmente per tener le voltages a basse nivellos sed etiam per producer un pellicula obscur e reguardar lo sub illumination brillante.

Es signalate le importantia de un attention concentrate in le examine de roentgenogrammas. Omne illuminatores non in uso deberea esser extinguite. Un masca de plumbo, facile a producer, es recommendate pro simplificar le examine de micro pelliculas in le illuminator de dimensiones standard.

Un troppo grande confidentia in berillos rubie, interferentia per lumine rubie, e le uso incorrecte del commutator pedal prejudicia le lectura fluoroscopic. Vision peripheric deberea esser usate habitualmente (excepte in le studio de motion rapide). Illo contribue grandemente a lo que pote esser vidite.

Treatment of the Internal Mammary Lymph Nodes by Implantation of Radioisotopes into the Internal Mammary Artery

RICHARD D. BRASFIELD, M.D., F.A.C.S., and ULRICH K. HENSCHKE, M.D., Ph.D.

A technic for the treatment of the lymph nodes along the internal mammary vessels in breast cancer has been developed in which radioactive sources are inserted into the internal mammary vessels. Usually the internal mammary artery is chosen.

At the conclusion of the radical mastectomy but before closure of the skin flaps, a small transverse incision is made in the first intercostal space on the side of the operation. The internal mammary vessels are exposed without entering the pleural cavity, and the internal mammary artery is ligated as close as possible to the first rib. With a knife, a small slit is made in the artery just below the ligature. A small nylon tube, whose leading end has previously been closed by heat, is introduced through the slit into the artery. The tube can usually be threaded down for approximately 15 to 25 cm., to a point below the level of the xiphoid process. A ligature is then tied around the artery directly below the slit to prevent back bleeding. The end of the nylon tube outside of the artery is brought out through the skin in the supraclavicular fossa by threading it through a large-bore hypodermic needle. The radical mastectomy is then completed in the routine manner.

The whole implantation procedure can be carried out in five minutes. In a few instances, the technic has been modified by implanting both the internal mammary artery and the vein or both internal mammary arteries at the same time. Ligation of the internal mammary vessels is simple and carries no risk.

After the patient has returned to her room, radioactive sources are introduced into the whole length of the inserted nylon tube. Ir^{192} sources have been used in most of our applications, but other radioisotopes such as Co^{60} or Ta^{182} are also suitable. These radioactive sources are left in place until the desired dose is reached, usually five to ten days. Doses up to 9,000 r, calculated at a point 0.5 cm. from the middle of the radioactive sources, have been delivered in patients, and up to 25,000 r in dogs, without untoward reactions.

It is felt that in many patients cancerocidal doses can be delivered to the nodes along the internal mammary vessels, because in most cases which are suitable for a radical mastectomy, the internal mammary nodes are small and lie close to the vessels. The procedure has been used clinically since January 1957 in 19 patients, and no complications have developed.

Memorial Center
New York 21, N. Y.

Preliminary Report on Trilafon in Radiation Sickness

ROBERT J. DICKSON, M.D.

The cause of radiation sickness is not clearly understood, as is evident from the variety of prophylactic and therapeutic agents which have been advocated. The administration of hydrochloric acid, cerium oxide, pyridoxine, antihistaminics, and chlorpromazine have all had a vogue, but the initial enthusiasm for each agent has usually waned as experience widened. One of the most recent substances to be used in the treatment of this unpleasant side-effect of radiation therapy is Trilafon (perphenazine), and as some encouraging results have been obtained, it is felt to be of interest to record them.

Trilafon has been used extensively in psychiatric practice in the alleviation of anxiety, tension, and psychomotor overactivity. As it is claimed to be a powerful antiemetic, its use in the therapy of radiation sickness was a natural extension of its clinical trials. It is available commercially in tablet form, but this annotation concerns the results obtained with an injectable solution kindly supplied by the manufacturers.

Choice of Patients: It is common knowledge that there is a powerful psychological element in the production of radiation sickness, and with experience one can foretell with some accuracy the patients who are likely to exhibit this troublesome side-effect of therapy. Furthermore, the administration of any placebo will not infrequently allay mild psychological nausea, as demonstrated by "double blind" studies with antihistaminic drugs. In two personal experiments, the patients whose symptoms were relieved most frequently were those receiving the placebo. An injection would be expected to have an even more beneficial effect. For these reasons, the patients chosen for this study were those with symptoms of nausea and vomiting severe enough to warrant temporary cessation of radiation therapy. As severe sickness is most common during abdominal irradiation, it is not surprising that all the patients in this small series were suffering from some intra-abdominal condition necessitating the use of comparatively large fields of treatment.

Carcinoma of cervix	3
Carcinoma of ovary	2
Roentgen castration	3
Hypernephroma	2
Abdominal metastases	1
Testicular tumor	1
Hemangioma of liver	1
	13

Dosage and Administration: With the first symptoms of nausea, Trilafon tablets in a dosage of 4 mg. t.i.d. were given, and only if the symptoms became more severe in spite of this therapy was intramuscular injection used. This is supplied in a strength of 5 mg. per c.c. and 1 c.c. was given intramuscularly following each daily x-ray treatment. This therapy was continued for periods as long as three weeks without the development of any signs of toxicity or of cumulative effect.

Results: The immediate effect of the first injection in several of these patients can be described as dramatic. With one exception, a patient with advanced ovarian carcinoma with gastrointestinal symptoms, they experienced considerable relief of both vomiting and nausea when present. One patient with bony metastases from mammary cancer, who was being castrated radiologically, was receiving daily injections of Trilafon when our supplies were exhausted. She was a hysterical patient in considerable pain and it was felt that her symptoms of radiation sickness were largely psychogenic. Injections of sterile water were then given, with relief as great as had been obtained with the active drug. This is the only case in the series, however, that responded in this fashion. The substitution of inert injections in two other patients failed to produce the desired relief.

At the present time, a double blind study is being run with Trilafon tablets and an inert tablet. In those patients who have not responded to the oral medication, improvement in symptoms has been noted after intramuscular injection of 5 mg. of Trilafon. This study will be fully reported when completed. The object of the present communication is to draw attention to the encouraging results which have been obtained in a small series of cases treated with Trilafon injectable.

NOTE: Supplies of Trilafon tablets and of Trilafon injectable were made available through the kindness of the Schering Corporation.

Johns Hopkins Hospital
Baltimore 5, Md.

REPORT ON 1956 AMENDMENTS TO THE RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION (ICRP)

When the International Commission on Radiological Protection met in Geneva in April 1956, before the Eighth International Congress of Radiology in Mexico in that year, major amendments to the 1954 recommendations were adopted concerning the basic concept of maximum permissible radiation exposure levels. A report was sent to the Executive Committee of the Congress, stating briefly the most essential points in reports from the Committees on special subjects. It was hoped that amendments to the recommendations published in 1955 would be made available within a short time, but as detailed new information was continuously received and prepared by some of the Committees, the final issue was deferred to make allowance for the most recent knowledge.

At present the Commission does not consider it possible to publish completely revised recommendations until the summer of 1958.[1] As, however, no official statement of the Commission has been issued since 1955, and the amendments made during the Geneva meeting are essential and imply substantial limitations of the maximum permissible exposure levels earlier recommended, the Commission has considered it advisable to promulgate the major points of the amendments which were adopted in Geneva.

(a) *Amendments to the Recommendations on "Permissible Dose for External Radiation"*[2]

Paragraph A.VI.1 reads unmodified concerning the exposure of *occupational workers*. For the definition of terms like "permissible" dose level the reader is referred to Chapter B of the 1955 recommendations.

For paragraph A.VI.2 the following two paragraphs were substituted:

2. *For Population Groups:* The recommendations of the I.C.R.P. formulated at its meeting in 1953 and published in 1955 dealt primarily with the protection of persons occupationally exposed to ionizing radiations and to radioactive material. The Commission recognized, also, its responsibility in regard to the protection of persons who might be exposed unknowingly in the neighbourhood of a plant or source of radiation, and recommended that "in the case of the prolonged exposure of a large population, the maximum permissible levels should be reduced by a factor of ten below those accepted for occupational exposure." It was envisaged at the time that in any practical case only a relatively small number of individuals in the immediate surroundings of an installation would be in the 10 per cent zone, and the bulk of the large population would receive much less radiation. It has come to the attention of the Commission that this provision may be misinterpreted and, therefore, a more explicit recommendation is now made in terms of "controlled" areas.

A *controlled area* is one in which the occupational exposure of personnel to radiation or radioactive material is under the supervision of a radiation safety officer.

For such personnel the maximum permissible levels of exposure are those specified for occupational exposure. In the case of prolonged exposure to radiation from external sources, the maximum permissible levels for occupational exposure are represented by weekly doses of 600 mrem in the skin and 300 mrem in the blood-forming organs, the gonads, and the lenses of the eyes. In the case of prolonged exposure to radioactive material that may enter the body, the maximum permissible levels of exposure are represented by the concentrations in air and water given in Table C.VIII of the 1954 report of Sub-Committee II.

For any person in any place outside of controlled areas the maximum permissible levels of exposure are 10 per cent of the occupational exposure levels. Under the conditions at present envisaged, the regions in which the 10 per cent level might be reached would contain a very small fraction of the population and, therefore, the average organ doses per individual of the whole population would be very much lower than 10 per cent of the maximum permissible organ doses for occupational exposure. (See also statement on genetic effects.)

3. *For the Entire Population:* The use of nuclear reactors for power production involves waste disposal and dispersion of radioactive material that may affect large sections of the population. The rapidly expanding use of radioactive materials in science and industry subjects more and more people to exposure to radiation. Therefore, genetic damage assumes greater importance. Designers of nuclear power plants, and others concerned with the peaceful application of atomic energy, cannot plan for the future in the present state of uncertainty as to what the genetic problem may mean in terms of a permissible level for the whole population. Realizing the importance and urgency of the matter, and cognizant of its responsibility to the public, the Commis-

[1] The ICRP will meet in March 1958, and it is very likely that its recommendations will then be further amplified.

[2] To be read in conjunction with the 1954 recommendations as published in the *British Journal of Radiology*, Supplement No. 6, 1955.

sion has decided to accelerate its study of the problem in order to be able to recommend in the near future a maximum permissible "genetic dose" applicable to the whole population. In the meantime, those concerned with the problem may be guided by the following statement:

When genetic aspects of the effects of radiation are considered, the dose received by the whole population is of importance. Scientific data derived from human as distinct from experimental animal populations are so scanty that no precise permissible dose for a population can, at present, be set. The available information is being assessed by the Commission and other groups including geneticists. Until general agreement is reached, it is prudent to limit the dose of radiation received by gametes from all sources additional to the natural background to an amount of the order of the natural background in presently inhabited regions of the earth.

The following sentence was added after 3 on page 20: 4. In exceptional cases in which it is necessary for a person to receive in one week more than the basic permissible weekly organ doses, the unit of time may be extended to thirteen weeks (1/4 year), provided that the total dose in any organ accumulated during a period of any thirteen consecutive weeks does not exceed ten times the respective basic permissible weekly dose.

The following new sections were added to Chapter B, where the former sections IV and V became VI and VII respectively:

IV: *Statistically Detectable Effects:* The definitions of permissible dose and permissible weekly dose are based on possible bodily injury manifestable in the lifetime of an individual. Since any such injury to a particular person that might result from exposure at present permissible limits would be very slight, and in view of large biological variations that always exist, certain types of injury cannot be detected in a single individual. This is particularly true in the case of a possible shortening of the life span. Therefore, it becomes necessary to consider injuries that become significant only when large groups are examined statistically.

The recommended maximum permissible weekly doses and the modified values for special circumstances permit a desirable degree of flexibility for their application. In practice it has been found that, in order not to exceed these maximum limits and also to comply with the general recommendations of the Commission "that exposure to radiation be kept at the lowest practicable level in all cases," a considerable factor of safety must be allowed in the design of protective devices and operating procedures. Therefore, under present conditions, it is expected that the average yearly occupational dose actually received by an occupationally exposed person would be about 5 rems and the accumulated dose in the employment period up to thirty years of age would be about 50 rems. Accordingly, the Committee recommends continuation of the present conservative practice as regards doses actually received by occupationally exposed personnel, to keep the accumulated dose as low as practicable, especially up to age thirty.

V: *Pregnant Women:* Since it is known from animal experiments that the embryo is very radiosensitive, special care should be exercised to make sure that pregnant women are not occupationally exposed under conditions in which, through some accident or otherwise, they may be exposed to large doses of penetrating radiation. When the exposure cannot exceed the basic permissible weekly dose, however, no special provisions need be made.

(*b*) *Amendments to the Recommendations on "Permissible Dose for Internal Radiation"*

It was proposed that the maximum permissible weekly dose for occupational exposure continue to be 0.3 rem for all organs of the body with the exception of the gonads and the total body. In cases in which the gonads are the critical body organs, the maximum permissible weekly dose was reduced to 0.1 rem in order to limit the gonad dose to not more than 50 rem before the age of thirty. This reduction was made with the intention of preventing damage to man during his most reproductive period. In the cases where the total body is the critical organ, the maximum permissible weekly dose was again set at 0.1 rem. This reduction will limit the accumulated dose in the total body up to the age of sixty to not more than 200 rem and is intended to reduce the probability of damage resulting from total body exposure, *e.g.*, reduce the probability of leukaemia and reduce the possibility of shortening the life span of the individual.

Members of The International Commission on Radiological Protection presenting the report:

Sir Ernest Rock Carling (*Chairman*)	R. G. Jaeger
W. Binks (*Secretary*)	W. V. Mayneord
L. Bugnard	K. Z. Morgan
G. Failla	R. M. Sievert
H. Holthusen	R. S. Stone
J. C. Jacobsen	L. S. Taylor

EDITORIAL

Leo G. Rigler, M.D.

President of the Radiological Society of North America

Dr. Leo G. Rigler, the new president of the Radiological Society of North America, has long been known internationally as a radiologist, teacher, and clinician. Although his contributions to medicine and radiology are legion, he will be best remembered by his students for his extraordinary ability and tireless enthusiasm as a teacher. Perhaps because of his background in general practice and early training in internal medicine and pathology, but more likely because he is Leo Rigler, he possesses an unusual faculty for correlating the roentgen findings with the clinical signs and pathology. Drawing from a vast storehouse of general medical knowledge, he approaches diagnostic problems in an analytical and logical manner and almost invariably arrives at the correct diagnosis. In addition, he has a remarkable facility for interpreting radiology to medical students and to all other physicians, which has done much to give roentgen diagnosis its proper stature in medicine.

Dr. Leo G. Rigler was born in Minneapolis on Oct. 16, 1896. He obtained his early education in the public schools in Minneapolis and entered the University of Minnesota, where he obtained his academic and medical training, receiving his M.D. degree in 1920. While serving his internship in the St. Louis City Hospital, he came in contact with the stimulating work then being done by Dr. LeRoy Sante. This made a great impression on the young intern and kindled his interest in radiology.

After completing his internship in 1921, Doctor Rigler set up general practice in the small community of New England, North Dakota. He bought an x-ray machine and taught himself its use. He soon realized he would not be happy in general practice and returned to the University of Minnesota as a resident in internal medicine and pathology in 1922. During his residency it was noted that his major interest was in radiology and, fortunately for that specialty, he was soon given the opportunity to concentrate his training in that department. He has remained in radiology ever since. The latter part of the year 1924 was spent with Dr. J. T. Case at the Battle Creek Sanitarium and Dr. P. J. Hickey at the University of Michigan.

Doctor Rigler went to Sweden in 1926 and spent the greater part of the year with Dr. Gösta Forssell at the Caroline Institute in Stockholm. He became very proficient in Swedish during that year. After the completion of his work with Doctor Forssell, he spent some months visiting other European clinics.

Upon his return from Europe in 1927, Doctor Rigler was appointed associate professor of radiology at the University of Minnesota, and in 1929 became full professor. In 1935, he was made head of the Department of Radiology, a position which he held until his recent resignation, June 1957. He was also Chief of the Department of Radiology at the Minneapolis General Hospital from 1927 to 1957. During this same period, he was a radiological consultant to several hospitals in Minneapolis. From 1925 to 1936 he maintained a private office in downtown Minneapolis with Dr. Walter H. Ude.

The University of Minnesota erected a special and unique building in 1936, known as "The Center for Continuation

Study," to be devoted to postgraduate education. In 1937, Doctor Rigler established there an annual one-week course in postgraduate radiology. Many famous American and foreign radiologists have participated in the presentation of these courses and the attendance has risen steadily, being well over 300 in 1957.

Doctor Rigler served as senior consultant at the Veterans Administration Hospital in Minneapolis and is a consultant for the Tuberculosis Division of the U. S. Public Health Service and the Armed Forces Institute of Pathology. He is a member of the National Advisory Cancer Council, the Committee on Radiology of the National Research Council, the Lung Cancer Research Committee of the American Cancer Society, and a Trustee of the American Board of Radiology.

Doctor Rigler is a member or honorary member of many American radiological and medical societies and has held the following offices: first president of the Minnesota Radiological Society; president of the Minnesota Pathological Society; chancellor of the American College of Radiology; chairman of the Section of Radiology of the American Medical Association; trustee of the American Registry of X-ray Technicians, representing the Radiological Society of North America; and first vice-president of the Radiological Society of North America. He is a fellow of the American College of Radiology and the American College of Chest Physicians. He is an honorary member of nine foreign radiological and chest societies. He is an associate editor of RADIOLOGY, assistant editor of *Diseases of the Chest*, and on the editorial board of *Surgery and General Practice*.

He was sent to Japan as a consultant with the medical mission of the United States Army in 1950. As a member of the visiting team of scientists of the World Health Organization and Unitarian Service Committee, he visited Israel and Iran in 1951 and India in 1953.

He has given the following honorary lectures: Carman Lecture at the St. Louis County Medical Society; Pancoast Lecture in Philadelphia; Hickey Lecture in Detroit; Golden Lecture in New York; Radiology Lecture of the Canadian Medical Association; and the Crookshank Lecture in London, England. He will be the Caldwell Lecturer of the American Roentgen Ray Society in October 1958.

He has received the bronze medal of the American Medical Association, the silver medal of the Southern Minnesota Medical Association, the gold medal of the Radiological Society of North America, and the Crookshank palladium medal of the Faculty of Radiologists of Great Britain.

Doctor Rigler has edited or written three books. He has been the author or co-author of almost 200 papers. Some of the more important and original articles have dealt with the following: the early diagnosis and movement of pleural effusions; use of the visualized esophagus in the diagnosis of heart disease; roentgen visualization of the liver and spleen with thorium dioxide sol.; the early diagnosis, the duration, and evolution of carcinoma of the lung; the latent period in the roentgen diagnosis of pulmonary tuberculosis; the roentgenological manifestations of pulmonary edema; the early diagnosis of carcinoma of the stomach; pernicious anemia and tumors of the stomach; benign gastric tumors; acute abdominal conditions and intestinal obstruction.

In 1943, Dr. Walter H. Ude, with the assistance of Doctor Rigler's former students and his many friends, established an annual Rigler lectureship at the University of Minnesota. The Rigler Lecture is usually given at the time of the Continuation Course in Radiology and has been presented by outstanding radiologists in this country and abroad. This is one of the few lectureships established in honor of someone in his prime, and indicates the high position Doctor Rigler holds in the eyes of his colleagues. Dr. Fred Jenner Hodges, Professor of Radiology at the University of Michigan and long time friend

LEO G. RIGLER, M. D.

President of the Radiological Society of North America

of Doctor Rigler, presented the first Rigler Lecture. Doctor Rigler was further honored in 1952, when his former students and friends arranged to present him with an oil painting of himself.

In 1920, Doctor Rigler was married to Matyl Sprung, a college classmate. They have three children—Ruth, Nancy, and Stanley or "Jack." Ruth is a writer and a story analyst. Nancy Rigler Saxon is married to a resident in surgery at the University of Minnesota, and they have three children. Dr. "Jack" Rigler is a resident in surgery at the University of Chicago. Matyl Rigler has always held open house whenever a visiting radiologist was in Minneapolis. She is a charming and gracious hostess, and many radiologists from all parts of the world have enjoyed the Rigler hospitality.

In 1957, Doctor Rigler resigned his professorship at the University of Minnesota and moved to Los Angeles. This was perhaps the most difficult decision of his career. He continues to be more active than most young men in radiology in his capacity as consultant and director of education in the Department of Radiology at the Cedars of Lebanon Hospital, Los Angeles, and visiting professor of Radiology at the University of California, Los Angeles, in addition to his many duties with national societies and worldwide lecture commitments.

The Radiological Society of North America has not only honored Dr. Leo G. Rigler, but has honored itself in electing him its president.

H. MILTON BERG, M.D.
HAROLD O. PETERSON, M.D.

Forty-Third Annual Meeting

The Forty-Third Annual Meeting of the Radiological Society of North America, held in the Palmer House, Chicago, Nov. 17–22, 1957, was the largest meeting of this society to date, with a total registration of 2,947. The program as arranged by the President, Dr. C. Edgar Virden, was of interest to all those who work with radiation, with contributions on diagnosis, therapy, physics, and biology. Two sections, A and B, occupied each morning from Tuesday through Friday, with a combined session in the afternoon, Monday through Thursday. A third section, C, presenting recent advances in radiologic physics, met on Wednesday afternoon.

The usual Therapy Information Session was held on Sunday at 2:00, with Dr. Sydney F. Thomas as Moderator, and the always popular Film Reading Session from 7:30 to 9:30, with Dr. John A. Evans presiding. The panel of diagnostic experts included Dr. William R. Eyler of Detroit, Mich.; Dr. Ted F. Leigh of Emory University, Ga.; Dr. C. Richard Perryman of Pittsburgh, Penna.; Dr. Stanley M. Wyman of Boston, Mass. A capacity crowd enjoyed the lively exchange of opinion on this occasion. Between the Sunday afternoon and evening sessions, a number of Refresher Courses were conducted on both diagnostic and therapeutic subjects.

To meet the demand for an enlarged Refresher Course program, the formal opening of the meeting was postponed to Monday afternoon, when Dr. C. Edgar Virden delivered the Presidential Address. This was followed by a special Memorial Fund Lecture, "The Natural History of Multiple Myeloma Before Radiological Evidence of Disease," by Dr. Elliott Osserman of New York City. A symposium on "Reactions from Intravenous Organic Iodide Compounds," arranged and directed by Dr. Everett L. Pirkey of Louisville, Ky., completed the program for the afternoon.

In Section A on Tuesday morning, a group of diagnostic papers was presented, largely devoted to the gastrointestinal tract. Section B was given over to a symposium of universal interest: Patient

Exposure in Diagnostic Procedures. Many of the practical aspects of this important subject were discussed. On Tuesday afternoon Sections A and B met for a program on physics and therapy.

Pulmonary diagnostic problems were considered in Section A on Wednesday morning, concluding with a symposium on the current management of pulmonary tuberculosis. In Section B, Cobalt-60 therapy was the subject of discussion. The first half of the combined Wednesday afternoon session was devoted to pathology and biology. The second half was a panel discussion of patient dosage in diagnostic

Dr. Virden, Dr. Eugene P. Pendergrass, and Dr. Henry P. Pendergrass

radiology under the direction of Dr. Earl R. Miller of San Francisco. This not only brought out the problem with which we are faced, but also gave many practical methods of reducing patient dose. Section C, "Recent Advances in Radiological Physics," arranged by Dr. Harold O. Wyckoff of Washington, D. C., met at this time.

On Thursday morning, Section A presented a symposium on "Occlusive Cerebral Vascular Diseases," a well co-ordinated group of papers arranged by Dr. James E. Lofstrom of Detroit. This was followed by papers on Angiocardiography and Pulmonary Emphysema. Section B was devoted to a symposium on "Neutron Reactors and Radiobiology," arranged by

Dr. Virden, Dr. Merrill G. Sosman and Dr. John L. Sosman

Dr. S. F. Williams of Bethesda, Md. On Thursday afternoon, a pediatric panel arranged by Dr. John W. Hope of Philadelphia attracted a large audience.

This year the usual banquet was omitted and the Carman Lecture was given on Thursday evening, by Dr. L. Henry Garland of San Francisco. His excellent lecture on "Treatment of Carcinoma of the Breast" is printed in this issue of RADIOLOGY. At the conclusion of his address, Dr. Garland was presented with an illuminated scroll as an expression of the appreciation of the Society. Following the lecture, the Gold Medal of the Society was bestowed upon Dr. Eugene P. Pendergrass and Dr. Merrill C. Sosman, who were cited for their outstanding contributions in research and teaching during their long and illustrious careers. Special interest was loaned to the presentation by the fact that the sons of the two medalists, who have followed in their fathers' footsteps professionally, were called to the platform to assist in the ceremony. Dr. Virden then presented the Pfahler gavel to Dr. Leo G. Rigler, who was elected President to take the place of the late Dr. Sidney S. Hawley. Other newly elected officers were announced as follows: President-Elect, Laurence L. Robbins; First Vice-President, Robert D. Moreton; Second Vice-President, James W. Carpender; Third Vice-

President, Everett L. Pirkey; Secretary-Treasurer, Donald S. Childs; Historian, Howard P. Doub; Director, Ivan J. Miller.

The two closing sections on Friday morning included a symposium on the lumbosacral spine arranged by Dr. Robert D. Moreton of Fort Worth, Texas, and a group of papers on dosimetry.

The entire program was planned to present as much practical information as possible, and many favorable comments were heard regarding it. For its conception and execution, Dr. Virden deserves great credit. The scientific exhibits were especially well attended and were of high caliber. The commercial exhibits, listed in an earlier issue of RADIOLOGY, attracted many visitors. The large attendance at the meeting is indicative of its importance and the high esteem in which it is held by the radiologists of this country.

The Scientific Exhibits

The scientific exhibits at the Forty-Third Annual Meeting were excellent both in content and range of subjects. Additional floor space, plus elimination of some exhibits of the large cabinet type, provided more aisle space and comfort for the viewers.

In response to written requests, many exhibitors spent a large portion of their time at their exhibits, explaining points of interest and answering questions. In some individual instances, these efforts reached heroic proportions. Attendance in the evening hours increased over last year. Possibly this is to be expected as a reflection of the increased registration.

The "Case of the Day" exhibit was presented by Dr. Ted Leigh and his associates. Special thanks are due them for the work involved in the preparation of the cases and the daily audit of the submitted diagnoses.

There is an increasing use of the medium of the Scientific Exhibit for the demonstration of fundamental investigation. This is obvious from the report of the Secret Committee on Awards, which follows:

Clinical Investigation

Summa Cum Laude. Occlusive Cerebrovascular Disease. J. E. LOFSTROM, M.D., J. E. WEBSTER, M.D., J. L. CHASON, M.D., M. TATELMAN, M.D., J. S. MEYER, M.D., E. S. GURDJIAN, M.D., Detroit, Mich.

Magna Cum Laude. Aortic Valvulography and Ascending Aortography. WILLIAM MOLNAR, M.D., SIDNEY W. NELSON, M.D., KARL P. KLASSEN, M.D., JOSEPH M. RYAN, M.D., Columbus, Ohio.

Cum Laude. Pneumotomographic Visualization of the Pancreas. HANS LUDIN, M.D., THANE ASCH, M.D., and JOHN A. EVANS, M.D., New York, N. Y.

Certificate of Merit. Osteoid Osteoma, a Teaching Exhibit. ROBERT H. FREIBERGER, M.D., BERNARD S. LOITMAN, M.D., MILTON HELPERN, M.D., T. C. THOMPSON, M.D., New York, N. Y.

Honorable Mention. Carcinoma of the Lung: Nodular Peripheral Type. Contributions to Its Differential Diagnosis. RAFAEL GOMEZ-ZALDIVAR, M.D., AND LAURA FARIÑAS, M.D., Havana, Cuba.

Fundamental Investigation.

Summa Cum Laude. Bone and Gonad Dose Incident to Diagnostic Procedures. J. S. LAUGHLIN, Ph.D., R. GARRETT, M.S., O. TAMUZS, M.S., M. L. MEURK, B.A., R. S. SHERMAN, M.D., New York, N. Y.

Magna Cum Laude. Coronary Arteriography—a New Technic. CHARLES T. DOTTER, M.D., AND LOUIS H. FRISCHE, M.D., Portland, Ore.

Cum Laude. Circulation in the Tumor Bed and Growth of Epithelioma and Adenocarcinoma. MAURICE LENZ, M.D., New York, N.Y.

Certificate of Merit. Axial Transverse Planigraphy of the Chest. STEFAN P. WILK, M.D., Los Angeles, Calif.

Honorable Mention. Pulmonary Microarteriography. (A New Technic to Visualize Pathological Changes in the Pulmonary Vascular Bed). HERBERT F. HEMPEL, M.D., A. L. LOOMIS BELL, JR., M.D., SEIICHI SHIMOMURA, M.D., AND ERIC ANDRAE, M.D., New York, N. Y.

Special Award (Noncompetitive). Clinical Experiences with Radiation Therapy of Race Horses. EUGENE F. LUTTERBECK, M.D., AND PAUL J. MEGINNIS, D.V.M., Chicago, Ill.

Other exhibits were:

Contrast Radiography of the Salivary Glands. ARNOLD J. BAJEK, M.D., New York, N. Y.

Erosive Rib Lesions in Paralytic Poliomyelitis. CHARLES BERNSTEIN, M.D., WILLIAM D. LOESER, M.D., AND LEO J. MANNING, M.D., Buffalo, N. Y.

Photomechanical Contour Projector. R. K. CLARK, Ph.D., AND W. T. POWERS, B.S., Chicago, Ill.

Preparing Isodose Curves. VINCENT P. COLLINS AND WALTON D. WEST, M.Sc., Houston, Texas.

The Cardiac Silhouette in Newborn Infants—What Significance? GEORGE COOPER, JR., M.D., AND JAMES M. CARTER, M.D., University, Va.

Use of Polaroid Land Camera for Making Standard Lantern Slides of Roentgenograms. IRVING I. COWAN, M.D., AND LAVERN W. HOFFMAN, Milwaukee, Wisc.

The Gastrointestinal Tract Examination in Infancy Using a Water-Soluble Opaque. LAWRENCE A. DAVIS, M.D., AND EVERETT L. PIRKEY, M.D., Louisville, Ky.

Juxta-Articular Ossification of the Ligaments of the Vertebral Column. DAVID E. EHRLICH, M.D., CHARLES J. SUTRO, M.D., AND MORRIS WITTEN, M.D., Brooklyn, N. Y.

Lobar Emphysema. HARRY W. FISHER, M.D., AND EUGENE F. VAN EPPS, M.D., Iowa City, Iowa.

Chemopallidectomy—The Radiologist's Role. WALTER FRANCKE, M.D., AND J. T. SCHWIDDE, M.D., Billings, Mont.

Placentography with Duo- and Tri-Speed Intensifying Screens. ABRAHAM GEFFEN, M.D., New York, N. Y.

Motion Studies of the Normal and Paralyzed Diaphragm in Obstructive Emphysema: An Evaluation of a Roentgen Kymographic Technic. SUMNER GOLDENTHAL, M.D., LEONARD DAVIS, M.D., ROBERT M. LOWMAN, M.D., New Haven, Conn.

The Angled Postero-anterior Projection of the Stomach. SEWELL S. GORDON, M.D., Minneapolis, Minn.

Roentgen Manifestations of Acute Leukemia. THEODORE F. HILBISH, M.D., BYRON E. BESSE, JR., M.D., LEE B. LUSTED, M.D., LOUIS B. THOMAS, M.D., Bethesda, Md.

Lower Intestinal Obstruction of Infancy. WILLIAM H. R. HOWARD, M.D., AND ROBERT J. IZANT, JR., M.D., Columbus, Ohio.

Dose Distribution About Large Circular and Linear Sources of Gamma Radiation. IRVIN F. HUMMON, M.D, AND ROBERT S. LANDAUER, Ph.D., Chicago, Ill.

Pulmonary Torulosis. LEWIS G. JACOBS, M.D., Oakland, Calif.

The Vaterian Segment: Fundamental Considerations. HAROLD G. JACOBSON, M.D., MAXWELL H. POPPEL, M.D., AND JEROME H. SHAPIRO, M.D., New York, N. Y.

Intestinal Obstruction and Adynamic Ileus—Roentgen Differentiation. I. E. KIRSH, M.D., AND GEORGE KOPTIK, M.D., Hines, Ill.

Roentgenography of the Breast. V. KREMENS, M.D., J. GERSHON-COHEN, M.D., S. M. BERGER, M.D., H. INGLEBY, M.D., Philadelphia, Penna.

Complications Following Intensive Cobalt 60 Teletherapy to Intrathoracic Lesions. EUGENE R. KUTZ, M.D., Pittsburgh, Penna.

The Roentgen Findings in Lymphosarcoma of the Small Intestine. RICHARD H. MARSHAK, M.D., BERNARD S. WOLF, M.D., AND JOAN ELIASOPH, M.D., New York, N. Y.

The Regional Manifestations of Scleroderma. WILLIAM T. MESZAROS, M.D., Chicago, Ill.

Arthritis in Swine. PAUL T. MEYERS, M.D., Bloomfield, Iowa.

Emphysema Studied by Microradiography. CHARLES ODERR, M.D., PHILIP PIZZOLATO, M.D., AND JOSEPH ZISKIND, M.D., New Orleans, La.

Direct Color Radiography. C. O. ONSTEAD, M.D., J. C. SHEPARD, J. T. LING, M.D., AND A. T. KREBS, Ph.D., Fort Knox, Ky.

A Primer on Radiation Hazards for Physicians. R. E. PETERSON, M.D., JULIUS G. BARON, M.D., BARTIS M. KENT, M.D., TITUS C. EVANS, Ph.D., Iowa City, Iowa.

The Nature of the Effect of ACTH and Cortisone on Tumor Growth in Irradiated Animals. HENRY P. PLENK, M.D., AND ROBERT B. FUSON, M.S., Salt Lake City, Utah.

Pulmonary Blastomycosis: Past and Present Concepts of Treatment. ROBERT J. REEVES, M.D., CHARLES RENNELL, M.D., AND SELBY COFFMAN, M.D., Durham, N. C.

Plain Film Diagnosis of Fulminating Colitis. LAURENCE L. ROBBINS, M.D., FLEMING MCCONNELL, M.D., AND JOSEPH HANELIN, M.D., Boston, Mass.

The Cisterns in Pneumoencephalography. ALFRED L. SCHMITZ, M.D., San Francisco, Calif.

Carcinoma of the Cervix—Radiation or Surgery. HERBERT E. SCHMITZ, M.D., COLIN B. SCHACK, M.D., NATHAN TOPEK, M.D., DAVID FOLEY, M.D., Chicago, Ill.

Extended Range Radiography. GERHART S. SCHWARZ, M.D., New York, N. Y.

Kilovoltage and Grid Relationships in Radiography of a Pelvic Phantom. H. E. SEEMANN, Ph.D., AND H. R. SPLETTSTOSSER, B.S., Rochester, N. Y.

A Projection X-Ray Microscope Using Electrostatic Focusing. E. DALE TROUT, D.Sc., JOHN P. KELLEY, B.S., AND ARTHUR C. LUCAS, B.S., Milwaukee, Wisc.

Reactions to Reactions. JOHN F. WEIGEN, M.D., AND SYDNEY F. THOMAS, M.D., Palo Alto, Calif.

Metastatic Lesions to the Large Intestine. RUSSELL WIGH, M.D., Augusta, Ga., AND NORAH DU V. TAPLEY, M.D., New York, N. Y.

Contrast Visualization of Lymph Nodes. NORMAN ZHEUTLIN, M.D., AND EDWARD SHANBROM, M.D., Duarte, Calif.

We wish to thank the Local Committee under the Chairmanship of Dr. Benjamin D. Braun for their invaluable assistance.

EVERETT L. PIRKEY, M.D.
BENJAMIN D. BRAUN, M.D.
TED F. LEIGH, M.D.
FREDERICK W. O'BRIEN, JR., M.D.
GIBBONS W. MURPHY, M.D.
HERBERT H. VIRDEN, M.D.
WEBSTER H. BROWN, M.D.
IVAN J. MILLER, M.D., *Chairman*

Refresher Courses

The Refresher Courses continue to be an important feature of the Annual Meeting of the Radiological Society of North America. In fact, they have become increasingly popular. A total of 53 courses were presented at the Meeting in November, with the largest enrollment in the history of the Society. On Sunday 1,327 members and guests attended the courses; Monday, 1,253; Tuesday, 1,348; Wednesday, 1,442; Thursday, 1,167; and Friday 1,042.

Several innovations in the form of presentation of the instruction courses took place this year. First, the members of the Society were given an advance notice of the program, and a total of 481 members availed themselves of the service. At the time of publication of RADIOLOGY no member had been refused any request that he made for a Refresher Course. Second, a series of courses were presented late Sunday afternoon. Third, two series of courses were presented on Monday morning.

A number of members and guests ordered Refresher Course tickets and then did not attend the meeting. It is unfortunate that this occurs, since the seating capacity of many of the courses is limited. An unclaimed ticket keeps another member from attending a "wanted" instruction course.

The Refresher Course Committee wishes to acknowledge the valuable contributions of the following to the Forty-third Annual Meeting of the Society:

Sydney F. Thomas, M.D.
Laurens P. White, M.D.
Thomas C. Pomeroy, M.D.
W. W. Wasson, M.D.
Louis H. Frische, M.D.
William R. Eyler, M.D.
Stanley M. Wyman, M.D.
J. Hale, Ph.D.
Kenneth Loeffler, M.D.
George Davis, M.D.
Milton Friedman, M.D.
Lucille DuSault, M.A.
Howard E. Skipper, Ph.D.
John W. Frost, M.D.
Manuel Garcia, M.D.
Gwilym S. Lodwick, M.D.
Arnold L. Bachman, M.D.
Ted F. Leigh, M.D.
Kenneth D. A. Allen, M.D.
H. Stephen Weens, M.D.
H. O. Wyckoff, Ph.D.
Lester W. Paul, M.D.
Lawrence A. Davis, M.D.
Robert J. Bloor, M.D.
James F. Holland, M.D.
Antolin Raventos, M.D.
Walter T. Murphy, M.D.
Charles T. Dotter, M.D.
John A. Evans, M.D.
C. Richard Perryman, M.D.
John H. Freed, M.D.
Robert Robbins, M.D.
C. Joseph Stetler
G. W. Morgan
Alfred L. Schmitz, M.D.
L. Henry Garland, M.D.
W. K. Sinclair, Ph.D.
Carl B. Braestrup, B.S., P.E.
M. L. Meurk, B.S.
Morton M. Kligerman, M.D.
J. R. Maxfield, Jr., M.D.
Benjamin Felson, M.D.
Harold Tivey, M.D.

Jesshill Love, M.D.
H. B. Elkins, M.D.
Richard H. Marshak, M.D.
Theodore P. Eberhard, M.D.
R. S. Sherman, M.D.
H. L. Friedell, M.D.
Stanley A. Lovstedt, D.D.S.
W. L. Russell
George R. Merriam, Jr., M.D.
Titus C. Evans, Ph.D.
Eugene L. Saenger, M.D.
Melvin M. Figley, M.D.
Robert D. Moseley, M.D.
Edith H. Quimby, Sc.D.
J. S. Krohmer, M.A.
Elizabeth F. Focht, B.A
Barton R. Young, M.D.
M. H. Wittenborg, M.D.
John Reeves, M.D.
John P. Storaasli, M.D.

The Committee is deeply indebted, also, to the Local Committee on Refresher Courses, headed by Robert B. Lewis, M.D. It is a diligent and hard working Committee, whose efforts represent a real contribution to the success of the Courses.

JOHN R. HODGSON, M.D.
RAYMOND R. LANIER, M.D.
JOHN S. LAUGHLIN, Ph.D.
JOHN W. WALKER, M.D., *Chairman*

MIAMI VALLEY RADIOLOGICAL SOCIETY

At a recent meeting of the Miami Valley Radiological Society, the following officers were elected for the coming year: President, A. J. Brogan, M.D., of Dayton; Vice-President, I. H. Altenburg, M.D., of Dayton; Secretary-Treasurer, G. F. Johnson, M.D., 1030 Reibold Bldg., Dayton 2, Ohio; American College of Radiology Counselor, G. A. Nicoll, M.D., of Dayton.

MONTANA RADIOLOGICAL SOCIETY

Newly elected officers of the Montana Radiological Society are: President, Dr. Richard Bridenbaugh of Billings; Vice-President, Dr. John Stewart of Billings; Secretary-Treasurer, Dr. Arthur T. Austin, 104 Doctors Bldg., Billings.

EASTERN RADIOLOGICAL SOCIETY

The first meeting of the newly incorporated Eastern Radiological Society will be held May 5–8, 1958, at Mid-Pines Club, Southern Pines, N. C. Reservations should be made early with the hotel management. Further information and application forms for membership in the Society may be obtained from Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna., President; George R. Krause, M.D., 10900 Carnegie Ave., Cleveland 6, Ohio, Vice-President; or John D. Osmond, Jr., M.D., Euclid-Glenville Hospital, Cleveland 19, Ohio, Secretary-Treasurer.

COURSE ON RADIOISOTOPES INDIANA UNIVERSITY

A full-time postgraduate course on Clinical Uses of Radioisotopes will be given by the Department of Radiology of the Indiana University School of Medicine at Indianapolis, April 7–19, 1958.

The first week of the course will consist of lectures and demonstrations on the physics, biophysics, and diagnostic and therapeutic applications of isotopes. The second week will be devoted to the laboratory application of the material covered in the preceding week. Here the registrant will perform supervised radioisotope procedures, utilizing different diagnostic and therapeutic applications with a variety of equipment and methods.

Enrollment for the course is limited to 50 for the lectures and 20 for the laboratory. The fee is $100 for each half of the course. For further information, address Dr. J. A. Campbell, Indiana University Medical Center, 1100 West Michigan St., Indianapolis 7.

THIRD INTERNATIONAL CONGRESS OF PHOTOFLUOROGRAPHY

The Third International Congress of Photofluorography, organized by the International Society of Photofluorography with the co-operation of the International Union Against Tuberculosis, will be held Aug. 20–23, 1958, at Stockholm, Sweden. The President of the Congress is Carl Wegelius and the Secretaries General are Ingvar Ståhle and Hanns J. Bauer.

Information regarding program and exhibits and details of registration may be obtained by application to the Congress Secretariat, Post-Box 5097, Stockholm 5, Sweden.

FREEDMAN LECTURES UNIVERSITY OF CINCINNATI

On Saturday and Sunday, March 29 and 30, 1958, Dr. Laurence L. Robbins, Radiologist-In-Chief, Massachusetts General Hospital, Boston, will deliver the 10th Annual Joseph and Samuel Freedman Lectures in Diagnostic Radiology at the University of Cincinnati College of Medicine. Radiologists desiring to attend are requested to write Dr. Benjamin Felson, X-ray Department, Cincinnati General Hospital, for further details.

DAVID ANDERSON-BERRY MEDAL

A David Anderson-Berry silver-gilt medal, together with a sum of money amounting to not less than £100, will be awarded in 1958 by the Council of the Royal Society of Edinburgh for recent work on the effects of x-rays and other forms of radiation on living tissues. Published work submitted to the Society with the application will be taken into consideration. In addition to direct application for the prize, proposals in behalf of others may be made.

Applications and proposals must be in the hands of the General Secretary, Royal Society of Edinburgh, 22,24 George St., Edinburgh 2, Scotland, not later than March 31, 1958.

Letter to the Editor

We are especially happy to print here a letter recently received from a long-time member of the Radiological Society of North America. It expresses, we are sure, the feelings of many.—Ed.

To the Editor of Radiology

Dear Dr. Doub:

Too often we are prone to take things for granted without fully appreciating their value. I have reference here to the Refresher Courses presented each

year at the Annual Meeting of our Society. The men who conduct these courses give generously of their time and, in many cases, bear a share of the expense as well. Many of them have trained themselves in the technics of teaching and know how to inject just the right degree of humor to drive home the points which they wish to make.

At the recent meeting in Chicago, the lecturer frequently concluded: "Thank you for listening." It seems to me that those of us who are the recipients of the information should be the ones to express gratitude. The lecturers have worked hard and are sharing freely of their observations and experience without other reward than that they have been of help to a colleague.

I feel sure that I speak for many who, like myself, have benefited greatly by attendance at these courses and have been able to treat patients more wisely because someone has made special studies and has been willing to share the results.

Sincerely yours

ARTHUR E. PERLEY, M.D.

Waterloo, Iowa

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE LOWER URINARY TRACT IN CHILDHOOD: SOME CORRELATED CLINICAL AND ROENTGENOLOGICAL OBSERVATIONS. By SVEN ROLAND KJELLBERG, NILS OLOF ERICSSON, AND ULF RUDHE. A volume of 298 pages, with 265 figures, mostly roentgenograms. Published by The Year Book Publishers, Inc., Chicago, Ill., 1957. Price $18.00.

THE POSTOPERATIVE CHEST: RADIOGRAPHIC CONSIDERATIONS AFTER THORACIC SURGERY. By HIRAM T. LANGSTON, M.D., ANTON M. PANTONE, M.D., MYRON MELAMED, M.D. Publication Number II, The John Alexander Monograph Series on Various Phases of Thoracic Surgery. A monograph of 228 pages, with 190 roentgenograms with accompanying diagrams. Published by Charles C Thomas, Springfield, Ill., 1958. Price $8.00.

THE YEAR BOOK OF RADIOLOGY (1957-1958 YEAR BOOK SERIES). RADIOLOGIC DIAGNOSIS. Edited by JOHN FLOYD HOLT, M.D., Professor, Department of Radiology, University of Michigan, and FRED JENNER HODGES, Professor and Chairman, Department of Radiology, University of Michigan. RADIATION THERAPY. Edited by HAROLD W. JACOX, M.D., Professor of Radiology, College of Physicians and Surgeons, Columbia University; Chief, Radiation Therapy Division, Radiologic Service, Presbyterian Hospital, New York City, and MORTON M. KLIGERMAN, M.D., Associate Professor of Radiology, College of Physicians and Surgeons, Columbia University; Associate Attending Radiologist, Presbyterian Hospital, New York City. A volume of 446 pages, with 335 figures. Published by The Year Book Publishers, Inc., Chicago, Ill., 1957. Price $10.00.

ANNUAL REVIEW OF NUCLEAR SCIENCE. VOLUME 7. Editor: JAMES G. BECKERLEY, Schlumberger Well Surveying Corporation. Associate Editors: ROBERT HOFSTADTER AND LEONARD I. SCHIFF, both of Stanford University. A volume of 496 pages, with charts and figures. Published by Annual Reviews, Inc., in co-operation with the National Research Council of the National Academy of Sciences, 1957. On sale by Annual Reviews, Inc., Palo Alto, Calif. Price $7.00, U. S. A.; $7.50 elsewhere.

LA BRONCOGRAFIA. By L. DI GUGLIELMO, Istituto di Radiologia dell'Università di Pavia, L. PIGORINI, Istituto "C. Forlanini" Clinica Tisiologica dell'Università di Roma, AND G. A. CITRONI, Clinica Otorinolaringoiatrica dell'Università di Pavia. A volume of 676 pages, with 621 figures, mostly roentgenograms. Published by "Il Pensiero Scientifico"—Editore, Via Brenta, 13, Rome, Italy, 1957. Price L. 15,000.

L'ENCÉPHALOGRAPHIE FRACTIONNÉE. By GIOVANNI RUGGIERO, Laboratoire de Neuroradiologie du Centre Neurochirurgical de L'Hôpital Sainte-Anne. Prefaces by Pr Erik Lindgren and Pr Agr. Marcel David. A volume of 510 pages, with 288 figures, mostly roentgenograms. Published by Masson & Cie, 120, Boulevard Saint-Germain, Paris 6e, France, 1957.

ATLAS D'ANATOMIE STÉRÉOTAXIQUE: RÉPERAGE RADIOLOGIQUE INDIRECT DES NOYAUX GRIS CENTRAUX DES RÉGIONS MÉSENCÉPHALO-SOUS-OPTIQUE ET HYPOTHALAMIQUE DE L'HOMME. By J. TALAIRACH, M. DAVID, P. TOURNOUX, H. CORREDOR, AND T. KVASINA. A volume of 294 pages, with 99 figures in addition to 91 plates. Published by Masson & Cie, 120, Boulevard Saint-Germain, Paris 6e, France, 1957. Price 9,000 fr., paper; 10,000 fr., cloth.

LEHRBUCH DER RÖNTGENOLOGISCHEN DIFFERENTIALDIAGNOSTIK. BAND I: ERKRANKUNGEN DER BRUSTORGANE. By PROF. DR. WERNER TESCHENDORF, Cologne, with the assistance of Priv.-Doz. Dr. P. THURN, Bonn. A volume of 1,184 pages, with 1,138 figures, mostly roentgenograms. Published by Georg Thieme Verlag, Herdweg 63, (14a) Stuttgart, Germany, 4th ed., 1958. Dis-

tributed in the United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 210.—($50.00)

Book Reviews

BONE TUMORS. GENERAL ASPECTS AND AN ANALYSIS OF 2,276 CASES. By DAVID C. DAHLIN, M.D., Consultant, Section of Surgical Pathology, Mayo Clinic, and Associate Professor of Pathology, Mayo Foundation, Rochester, Minnesota. A volume of 224 pages, with numerous roentgenograms, photomicrographs, photographs, diagrams, charts, and 3 tables. Published by Charles C Thomas, Springfield, Ill., 1957. Price $11.50.

In this volume the author presents an analysis of more than 2,000 bone tumors seen at the Mayo Clinic. All were verified histologically.

A separate chapter is devoted to each type of tumor, with consideration of the incidence and clinical findings, as well as a brief description of the roentgen features. Somewhat more space is devoted to gross pathology and histopathology, which is natural since the author is a pathologist. The results of treatment and prognosis are also discussed. A short bibliography appears at the end of each chapter.

The text is well illustrated with charts, roentgenograms, photographs, and photomicrographs, to furnish a complete record. The last chapter is devoted to other conditions that commonly simulate primary tumors of bone.

This volume will be valuable as a short concise reference work on bone tumors as exemplified in the series presented. It will be of interest to surgeons, pathologists, radiologists, and students.

MEDICAL RADIATION BIOLOGY. By FRIEDRICH ELLINGER, M.D., Chief Radiation Biologist and Head Pharmacology Division, Naval Medical Research Institute; Member Radioisotope Board and Consultant to the Tumor Board, U. S. Naval Hospital, Bethesda, Maryland. A volume of 946 pages, with illustrations. Published by Charles C Thomas, Springfield, Ill., 1957. Price $20.00.

The title of this volume with its broad implications is justified by the contents. The entire spectrum of electromagnetic radiation from gamma rays, through ultraviolet and visible light, to infrared rays is covered, as well as alpha and beta radiation, including both the theoretical and the practical aspects of application to biological systems. Under Fundamental Radiation Biology there are considered such subjects as the mode of action of radiation, theories of biological effects, and influence of such factors as time on radiation effect. Under Biology of Ionizing Radiations the effect of radiation on skin, blood, endocrine glands, urinary tract, etc., is discussed for each of these tissues separately. Definite dosage figures are quoted here which should be of interest to radiotherapists in connection with tolerance of normal tissues and complications in radiation therapy. There is a description of the acute radiation syndrome and the lethal effect of radiation which includes means of modifying the effects of total body irradiation. The problem of radiotherapy of malignant neoplasms and allied diseases is discussed, both in detail for each site, and in general for factors affecting radiosensitivity. Clinical and research uses of isotopes are covered in the same detail. The chapter on Ionizing Radiation as a Health Hazard contains descriptions of technics for protection and a discussion of maximum permissible exposure and damage to the individual and to the race from overexposure.

The author has succeeded surprisingly well in gathering together a tremendous amount of information in orderly fashion. If at times there is some lack of critical selection, this is compensated for by elimination of personal bias. The bibliography of almost 5,000 references should permit the reader to form his own judgment of any work quoted. The wide scope of the book should mean that almost anyone concerned with radiation will find in it something of interest.

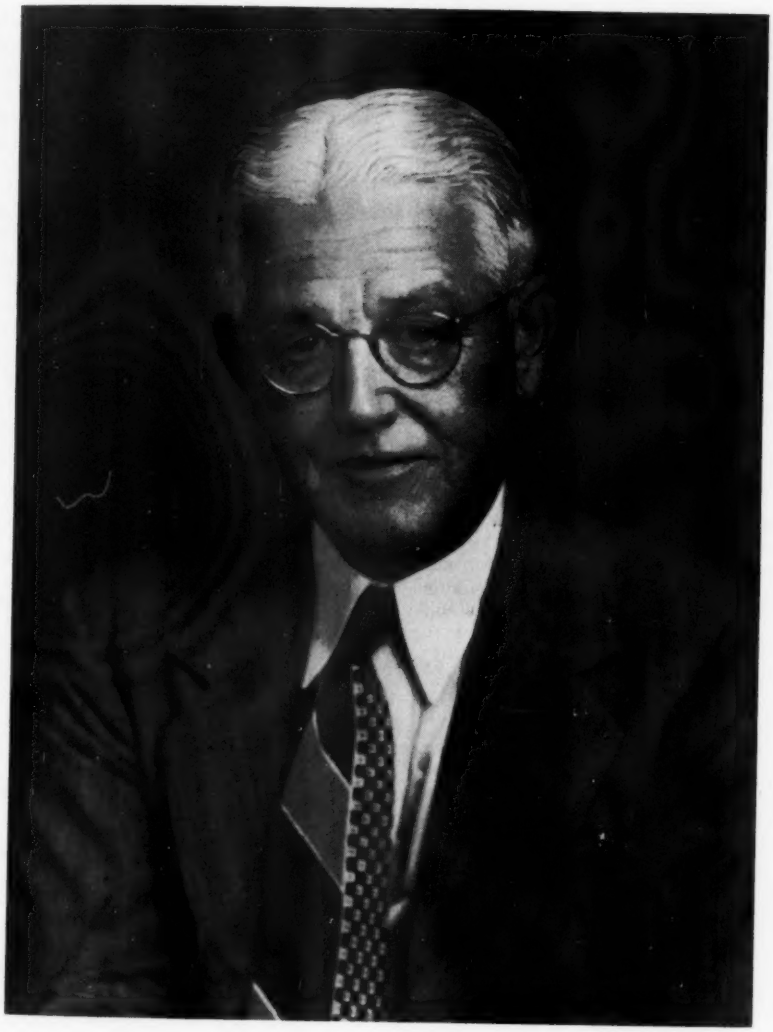
ADVANCES IN RADIOBIOLOGY. PROCEEDINGS OF THE FIFTH INTERNATIONAL CONFERENCE ON RADIOBIOLOGY HELD IN STOCKHOLM ON 15TH–19TH AUGUST, 1956. Edited by GEORGE CARL DE HEVESY, ARNE GUNNAR FORSSBERG, AND JOHN D. ABBATT. A volume of 504 pages, with numerous figures and tables. Published by Charles C Thomas, Springfield, Ill., 1957.

This report of the Fifth International Conference on Radiobiology contains much material of interest to radiologists, as well as to research workers in the field. In view of the recent publicity about the dangers of radiation exposure, the sections on genetic effects and of modification of radiation effects will be of particular interest.

While most of this work is, of necessity, done on animals, applications to man can be made, and some technics for analyzing data are described which can be used on any material. The distribution of strontium 90 in bones of rabbits and rats is an example, with its application to the problem of fall-out. Radiation leukemia is another example of material which will interest radiologists. Therapists, especially, will be interested in the discussion of oxygen, as well as various chemicals, as modifiers of radiation effect. Details of some experimental laboratory technics for alpha particle irradiation of single cells will be of help to the research worker.

This book gives a very good indication of the increasingly rapid progress which is being made in radiobiology as more investigators enter the field each year.

IN MEMORIAM



EUGENE THOMAS LEDDY, M.D.

1892–1958

Dr. Eugene Thomas Leddy, widely known specialist in x-ray treatment and a member of the staff of the Mayo Clinic for thirty-two years, died at St. Mary's Hospital in Rochester, Minn., on Jan. 5, 1958. He had retired from active practice on Oct. 1, 1957.

Dr. Leddy was born in Taunton, Mass., on Sept. 27, 1892, the son of Frances McMahon Leddy and Eugene Leddy. He received the degree of bachelor of arts in 1915 and that of doctor of medicine in 1919, both from Harvard University. He was an intern at Memorial Hospital in New York City for three months, and at Carney Hospital in Boston for six months. From 1920 to 1922 he was an assistant

at the Memorial Hospital, and from 1922 to 1925 was head of the Roentgen-Ray Department of the Philadelphia General Hospital. For six months in 1925 he carried on the private practice of roentgenology in Providence, R. I., where he was also head of the x-ray department at the Rhode Island Hospital.

Dr. Leddy went to Rochester, Minn., on Oct. 1, 1925, as a first assistant in therapeutic roentgenology. On April 1, 1929, he was appointed to the staff of the Mayo Clinic as a consultant in therapeutic roentgenology and as an instructor in radiology in the Mayo Foundation, Graduate School, University of Minnesota. He was advanced to assistant professor in 1933 and associate professor in 1937. He was certified as a specialist in radiology in 1934 by the American Board of Radiology. He was appointed head of the Section of Therapeutic Radiology at the Mayo Clinic on July 1, 1948, a post he held until April 1, 1953, when he became a senior consultant in therapeutic radiology.

Almost from the time of his graduation from medical school, Dr. Leddy devoted himself to the treatment of various conditions, especially cancer, with x-rays and radium. He was regarded as a pioneer in the medical uses of radium. His first paper, published in 1923, dealt with certain technical factors involved in the use of x-rays, and he was well known for his studies on the control of radiation and on dosages which could be administered with relative safety but would still embody the desired effectiveness. He also worked on analyses of the color of the skin after the administration of x-rays, in company with Dr. Charles Sheard. He was regarded as a national authority on the injuries which can be inflicted on physicians and technicians as a result of incomplete protection against x-rays as they are used in diagnosis and treatment. Privately he carried out studies on the effects of x-rays on flower seeds to determine the possible mutations which such treatment might produce, and he achieved considerable skill as a photographer.

For many years, as a member of the faculty of the Mayo Foundation, Dr. Leddy carried on a large part of the graduate instruction of fellows in the therapeutic use of x-rays. He read French, Italian, Spanish, and German medical literature with comparative ease, and hence was thoroughly conversant with advances in his field all over the world. He was a fellow of the American College of Radiology and a member of the American Medical Association, the American Roentgen Ray Society, the Radiological Society of North America, the American Radium Society, the Alumni Association of the Mayo Foundation, and the Society of the Sigma Xi. He was an honorary member of the Old Blockley Medical Society of Philadelphia.

Dr. Leddy was married to Miss Anna C. Regan on June 8, 1926. Mrs. Leddy and two children survive him: John Eugene Leddy and Anna Marie Leddy.

JAMES R. ECKMAN

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

JACKSON, HARRIS. Asymmetry and Growth of the Skull 280

HANKINSON, JOHN, AND AMADOR, LUIS V. Agenesis of the Corpus Callosum Diagnosed by Pneumoencephalography 280

KLAUS, E. Roentgen Diagnosis of Platybasia and Basilar Impression 281

GOVONI, ANTONIO F., AND EPSTEIN, BERNARD S. Cerebral Metastases 281

BAUMANN, CARL H. H., AND BUCY, PAUL C. Aneurysms on the Anterior Cerebral Artery: Evaluation of Surgical and "Conservative" Treatments 281

RUBIN, PHILIP, AND HOLT, JOHN F. Secretory Sialography in Diseases of the Major Salivary Glands 282

ARDRAN, G. M., ET AL. Swallowing Defects After Poliomyelitis 282

GURRIA, ANDRES BUSTAMANTE, AND DEUTSCH, LEO. Congenital Atresia of the Middle and External Ear 282

The Chest

ZUPPINGER, A., AND FRANK, L. Recent Developments in Roentgen Examination of the Thorax 283

RITTER, H., AND EYBAND, M. The Diagnostic Significance, in the Sagittal Chest Film, of a Shift in the Upper and Middle Lobe Fissures 283

JALET, JOSEPH, AND DUPLAN, MARCEL. On Clear Bordered Images of the Left Apex 283

FISCHER, E. Early Forms of Branched Pulmonary Ossification 284

HOLDEN, W. S., AND ARDRAN, G. M. Movements of the Trachea and Main Bronchi in Man ... 284

CHAMBERLIN, GEORGE W., ET AL. Chronic Pulmonary Disease Associated with Beryllium Dust 284

The Heart and Blood Vessels

EVANS, WILLIAM, AND LLOYD-THOMAS, H. G. The Syndrome of the Suspended Heart 285

VAN EPPS, E. F., AND MAHER, L. L. Radiologic Evaluation of Cardiovascular Anomalies Producing Pulmonary Vascular Engorgement .. 285

LEONARD, JAMES J., ET AL. Calcification of the Left Atrium 285

PATTINSON, J. NORMAN, AND EMANUEL, RICHARD W. The Aorta and Pulmonary Arteries in Fallot's Tetralogy 285

VOGT, A. Traumatic Cardiac Aneurysm; Calcified Cardiac Aneurysm 286

BERGSTRAND, I., AND EKMAN, C.-A. Lieno-Portal Venography in the Study of Portal Circulation in the Dog 286

BERGSTRAND, I., AND EKMAN, C.-A. Percutaneous Lieno-Portal Venography. Technique and Complications 286

HEITZMAN, E. ROBERT, JR., AND RIGLER, LEO G. Percutaneous Trans-splenic Portal Venography: Applications and Hazards 287

ANACKER, H., ET AL. The Usefulness and Limitations of Percutaneous Splenoportography ... 287

MIKKELSEN, WILLIAM P., AND PATTISON, ARTHUR C. Splenoportagraphy in Portal Hypertension: Its Value in Selecting the Operative Procedure of Choice 287

CHILD, CHARLES G., III, AND DONOVAN, ARTHUR J. Current Problems in Management of Patients with Portal Hypertension 288

The Digestive System

EBERL, J. The Picture of the Esophagus in Typical Changes in Form and Position 289

NELSON, SIDNEY W. The Roentgenologic Diagnosis of Esophageal Varices 289

BRICK, IRVING B. Early Diagnosis in Massive Upper Gastrointestinal Bleeding 289

DARDARI, M., AND CANOSSI, G. C. Personal Experience with Gastric Parietography 290

ELLIOTT, GLADDEN V., ET AL. A Roentgenologic Study of Ulcerating Lesions of the Stomach . 290

KATZ, ISADORE, AND BIERENBAUM, MARVIN L. Multiple Chronic Gastric Ulcers. Four Simultaneous Ulcers 291

DE LORIMIER, A. A., AND PENN, LLOYD. Acute Volvulus of the Stomach Emphasizing Management Hazards 291

DESMOND, A. M., AND SWYNNERTON, B. F. Adult Hypertrophy of the Pylorus 291

KEATS, THEODORE E., AND BRADY, RITA M. Duodenal Involvement in Regional Enteritis 291

SLOAN, ROBERT D. The Mucosal Pattern of the Mesenteric Small Intestine—an Anatomic Study 292

STRÖMME, AKSEL. Fluid Levels in Diverticula of the Small Intestine: A Radiological Sign Simulating Obstruction 292

WIETERSEN, FRED K. High Kilovoltage Method of Investigation of the Colon as a Routine Roentgenological Procedure 292

MOSIMANN, R., AND HOFSTETTER, J. Perforations of the Colon into the Free Peritoneal Cavity 292

DE ARZÚA ZULAICA, E. Filling Defect in the Colon 293

MCLAREN, J. W., ET AL. Further Observations on the Use of Dihydroxyphenylisatin in Barium Enemata 293

DREY, NORMAN W. Symptomatic Annular Pancreas in the Adult 293

HANSBROUGH, EUGENE T., AND LIPIN, RAYMOND J. Intrathoracic Accessory Lobe of the Liver 294
GORDON, SEWELL S. Compartmental Disease of the Gall Bladder: Cholecystography 294
GAGLIARDI, RAYMOND A., AND GELBACH, PHILIP D. Papilloma of the Gall Bladder 294

The Musculoskeletal System

MARTIN, JOHN R., AND JOHNSON, LOUIS. Multiple Myelomatosis. A Review Based on 68 Patients 294
DAVEY, P. W., ET AL. So-Called Eosinophilic Granuloma of Bone 294
O'CONNOR, SYLVESTER J., AND IVANOFF, JOHN C. Infantile Cortical Hyperostosis 295
BLAIR, JOSEPH R., ET AL. Sequelae to Cold Injury in One Hundred Patients 295
MUKHERJI, B. B. Skeletal Lesions of Infantile Syphilis 296
LEWTAS, N. A., AND DIMANT, STEVENS. The Diagnosis of Hypertrophic Interstitial Polyneuritis by Myelography 296
GREENWALD, CHARLES M., ET AL. Chordoma—Uncommon Destructive Lesion of Cerebrospinal Axis 297
ARD, ROBERT W. Paraplegia Caused by Unusual Extradural Granuloma Simulating Neoplasm; Case with Complete Recovery Following Surgical Removal 297
SHARP, JAMES. Differential Diagnosis of Ankylosing Spondylitis 298
TESCHENDORF, W. Double-Slot Exposures of the Spinal Column 298
MCKENZIE, A. H., AND DAY, F. G. Eosinophilic Granuloma of the Femoral Shaft Simulating Ewing's Sarcoma 299
CARROLL, ROBERT E. Osteogenic Sarcoma in the Hand 299
BOOHER, ROBERT J. Aneurysmal Bone Cyst of a Metatarsal 299
CATOLLA CAVALCANTI, G. Aseptic Osteonecrosis of the Posterior Epiphysis of the Calcaneus 299

Gynecology and Obstetrics

DE VILLIERS, P. D., AND BRINK, DONALD. Aortography: The Safest Means of Placental Localization? 300

The Genitourinary System

LASSER, ELLIOTT C., AND STAUBITZ, WILLIAM J. Translumbar Aortography in Urologic Diagnosis; Limitations and Possible Pitfalls 300
HARE, W. S. C. Damage to the Spinal Cord During Translumbar Aortography 300
ROTH, MERALL, AND NICHOLSON, THOMAS A. Comparative Study of Five Urographic Contrast Media 301
BECK, R. E., AND HAMMOND, R. CASE. Renal and Osseous Manifestation of Tuberous Sclerosis 301

The Spleen

ROSSETTI, M. Isolated Intrathoracic Displacement of the Spleen in Diaphragmatic Hernia 301

Miscellaneous

HARRISON, ISABELLA, ET AL. Studies on the Incidence and Duration of Postoperative Pneumoperitoneum 301

Technic

BUCHHEIM, C. E., ET AL. Improvement of Pneumoencephalography by High-Kilovoltage Technic 302
GREENWOOD, F. G. The Clinical Applications of Image Intensification. I. Cineradiography as a Routine Procedure 302
CRICHLOW, T. V. L. II. The Cricopharyngeus in Radiography and Cineradiography 302
ASTLEY, R., AND OLDHAM, J. S. III. Cineangiocardiography 302
ALLCOCK, J., AND BERRIDGE, F. R. IV. Some Applications of Cinematography to the Radiology of the Oesophagus 302
WEISER, MARTIN. Dark Adaptation and Aging of the Iris 303
BELLMAN, SVEN, AND ODÉN, BO. Experimental Micro-Lymphangiography 304
BOHATIRCHUK, F. P. Stain Historadiography 304

RADIOTHERAPY

HAAS, LEWIS, L., ET AL. Radiation Management of Apical Lung Tumors 304
WASSERBURGER, KARL. Treatment of Cancer of the Female Urethra 305

RADIOISOTOPES

SCHEER, KURT E. Interstitial Therapy with Radioactive Isotopes 305
SHELINE, GLENN E., ET AL. Thyroidal Accumulation of Radioiodine in Children 306
SKILLERN, PENN G., AND EVANS, BURTIS R. The Thyroid-Stimulating Hormone (TSH) Test. An Aid to the Differential Diagnosis of Nontoxic Disease of the Thyroid 306
ERMANS, A. M., AND BASTENIE, P. A. Differential Diagnosis of Hypophyseal Myxedema and Primary Hypothyroidism by Radioactive Iodine and Phosphorus Tests 306
BAUER, FRANZ K., AND BLAHD, WILLIAM H. Treatment of Hyperthyroidism with Individually Calculated Doses of I^{131} 307
MARKS, SIDNEY, ET AL. Histopathology of the Thyroid Gland of Sheep in Prolonged Administration of I^{131} 307
FEDORUK, SYLVIA O., AND JOHNS, H. E. Transmission Dose Measurement for Cobalt 60 Radiation with Special Reference to Rotation Therapy 307
CONN, HADLEY, L., JR., ET AL. "Left Heart"

Radiopotassium Dilution Curves in Patients with Rheumatic Mitral Valvular Disease... 307
FINK, SIDNEY, AND LASZLO, DANIEL. A Metabolic Study Following Oral Calcium[45] Administration in a Patient with Non-Tropical Sprue..... 308
SUIT, H. D., ET AL. Studies on the ^{59}Fe Uptake by Normoblasts and the Failure of X-Irradiation to Affect Uptake..... 308
MOORE, PATRICK T., AND MYERSCOUGH, PHILIP R. Clearance Rates of Radiosodium from Myometrium..... 308

RADIATION EFFECTS

BORGSTRÖM, KARL-ERIC, AND GYNNING, INGE. Roentgenographic Changes in the Lungs and Vertebrae Following Intense Rotation Roentgen Therapy of Esophageal Cancer..... 309
GOOLDEN, A. W. G., ET AL. Radiation Sialitis Following Radioiodine Therapy..... 309
BORA, K. C. Comparative Biologic Effects of 30 MeV_p and 220 kV_p Roentgen Rays and 0.4 MeV Gamma Rays at 8–9° C..... 309
EHLING, U., AND KROKOWSKI, E. Dependence of Roentgen Injury to Rabbit Eye upon the Dose and Quality of Radiation..... 309
VOGEL, HOWARD H., JR., ET AL. Comparative Mortality after 24-Hour, Whole-Body, Exposures of Mice to Fission Neutrons and Cobalt-60 Gamma-Rays..... 310
COLE, L. J., ET AL. Modification of Radiation Response in Mice by Heterologous and Isologous Bone Marrow..... 310
URSO, PAUL, AND CONGDON, C. C. The Effect of the Amount of Isologous Bone Marrow Injected on the Recovery of Hematopoietic Organs, Survival and Body Weight after Lethal Irradiation Injury in Mice..... 310
SILVERMAN, MYRON S., ET AL. Influence of Spleen Homogenate Injection on Postirradiation Infection..... 311
SHELLABARGER, C. J., ET AL. The Occurrence of Mammary Tumors in the Rat after Sublethal Whole-Body Irradiation..... 311
BLONDAL, H. Modification of Acute Irradiation Injury in Rats by Dextran..... 311
FAULKNER, WILLARD R., AND BLOOD, FRANK R. Effect of X-Irradiation on Myoglobin Content..... 311
HENLEY, CATHERINE, AND COSTELLO, DONALD P. The Effects of X-Irradiation on the Fertilized Eggs of the Annelid, Chaetopterus..... 312
FRITZ-NIGGLI, HEDI. Chemical Protection Against Enzymic Injury to Irradiation Mitochondria..... 312

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Asymmetry and Growth of the Skull. The Barclay Prize Essay, 1956. Harris Jackson. Brit. J. Radiol. **29:** 521–535, October 1956. (Johannesburg, Union of South Africa)

An understanding of the causes of asymmetry of the skull is important, since perfect symmetry in the sagittal plane does not occur; thus one must differentiate pathologic from anatomic variation. Proper evaluation of cranial symmetry requires precise radiography and a thorough acquaintance with cranial and facial anatomy.

Cranial asymmetry may be due to (1) intracranial, (2) cranial, or (3) extracranial causes. Cases of intracranial origin include those resulting from excessive growth stresses incident to space-occupying lesions. The author presents illustrative clinical cases of this type and comments on the cranial changes in each instance. These vary depending upon the anatomic location of the space-occupying lesion, whether it be extracerebral or intracerebral. Deficient growth stresses, as in cerebral atrophy, may also result in asymmetry. Unilateral cerebral atrophy may be indicated by the signs of thickening and smallness of one side of the cranial vault, hypertrophy of the ipsilateral paranasal sinuses, ipsilateral elevation of the orbits and of the petrous bones, smoothness of the petrous ridge, and displacement of the superior sagittal sinus groove and of the crista galli. A loss of convolutional markings may occur on the same side as the cerebral atrophy.

Cranial asymmetry may be the result of primary cranial disorders such as a deficient growth at the sutures (craniostenosis) or excessive growth (hemihypertrophy). As in the group of intracranial origin, illustrative clinical cases are presented, with appropriate comments.

Extracranial causes of asymmetry of the skull include endogenous and exogenous stresses. One example of extracranial pressure causing a scoliosis capitis is described. This condition is considered a physiologic change and is associated with prolonged recumbency in which one side is favored. It is also seen with torticollis and scoliosis of the spine.

The author believes that an evaluation of asymmetry is more accurate when the pattern of bone growth and development is considered than when precise measurements are taken. It is felt that the altered stresses are attributable primarily to the pressure or lack of pressure mechanically imposed upon the cranial vault during its developmental stage. This growth change is not a consequence of generalized intracranial pressure alterations, since the changes are not reflected in the opposite hemisphere. To the author the essential factor in growth alteration appears to be an enlarging solid or fluid mass in close proximity to the inner table of the vault. It may be that pulsation of the ventricular system plays a rôle in producing a thinning of the inner table on the ipsilateral side, as in some cases of the Sturge-Weber syndrome.

One sign that is believed to be useful in the evaluation of cranial asymmetry is elevation of the lesser wing of the sphenoid. Other forms of abnormality, *e.g.*, internal carotid aneurysm, porencephaly, and neurofibromatosis, may produce a similar alteration, indicating that it is not a specific observation; but it should never be disregarded.

Other signs of cranial asymmetry, such as displacement of the superior sagittal sinus groove, may be produced by absorption of bone on one side and deposition on the other, with the migration away from the side on which the growth is more rapid. Examples of bone deposition have also been seen as thickening of the inner table of the cranial vault, although the vault on the side of the thickening may be relatively atrophic. This thickening is believed to be the result of compensatory endosteal bone production as the brain strips away from the inner table.

The features discussed are seen in different examples of cranial asymmetry. A correlation of the various findings with the possible pathogenesis according to the altered stresses and strains associated with the underlying pathologic condition are all to be taken into consideration in the final interpretation of the basic etiology.

Twenty-five roentgenograms; 6 drawings; 2 tables.

JOHN W. WILSON, M.D.
Johnstown, Penna.

Agenesis of the Corpus Callosum Diagnosed by Pneumoencephalography. John Hankinson and Luis V. Amador. Brit. J. Radiol. **30:** 200–209, April 1957. (L. V. A., Children's Memorial Hospital, Chicago, Ill.)

Agenesis of the corpus callosum has been described many times from anatomical specimens, the first account being that of Reil in 1812. The diagnosis was first made in the living in 1934 by Davidoff and Dyke, who reported 2 cases recognized by pneumoencephalography. To date only 24 cases have been recorded in the literature in which agenesis has been diagnosed in life by air studies.

Agenesis of the corpus collosum may be either complete or partial. Many associated anomalies, mostly within the brain, have been described, and association with anomalies outside of the central nervous system is also noted. Hydrocephalus is present in about one-fifth of the cases but is not a result of agenesis.

There is no definite syndrome resulting from partial or complete absence of the corpus callosum, and the symptoms which commonly occur—convulsions, mental retardation, and hydrocephalus—are explainable only on the basis of the associated congenital abnormalities. The condition has been described in patients who had no significant neurological symptoms and were of average mentality.

The authors report 14 cases of agenesis of the corpus callosum diagnosed by pneumoencephalography. The age range in this series was from five weeks to fifty years. There are certain rather common symptoms seen both in infants and adults which, while they do not suggest the diagnosis, lead to roentgen study. In the infant group there are patients who fail to progress satisfactorily and are perhaps irritable and vomit from time to time. Usually no significant physical findings are detected except, occasionally, fullness of the fontanelles or other evidence of increased intracranial pressure. In other cases, convulsions, or, at a later age, frank mental retardation may be the presenting symptom. In adults the diagnosis is usually considered when there is epilepsy of late onset. These older patients appear to have average ability and apart from their occasional epileptic attacks lead normal lives.

The characteristic changes seen in the pneumoencephalogram are: (1) marked separation of the lateral ventricles; (2) angular dorsal margins of the lateral ventricles; (3) concave medial borders of the lateral ventricles; (4) dilatation of the caudal portions of the lateral ventricles; (5) elongation of the interventricular foramina; (6) dorsal extension and dilatation of the third ventricle; (7) radial arrangement of the medial cerebral sulci around the roof of the third ventricle and their extension through the zone usually occupied by the corpus callosum; (8) large cisterna magna. These criteria were first described by Davidoff and Dyke but are not all present in every case. Dorsal extension of the third ventricle is always a striking feature, however.

As might be expected in a condition resulting from failure of development in the central nervous system, there is little to offer in the way of treatment. The value of the recognition of agenesis of the corpus callosum lies in the avoidance of exploration and its disastrous consequences.

Twenty-six roentgenograms; 2 photographs; 1 table.

R. L. McDONALD, M.D.
University of Arkansas Medical Center

Roentgen Diagnosis of Platybasia and Basilar Impression: Further Experiences with a New Examination Method. E. Klaus. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 460–469, April 1957. (In German) (Pawlowstrasse 13, Olomouc, Czechoslovakia)

Platybasia and basilar impression are not identical, although they are almost invariably coincident. Anthropologists and anatomists apply the term platybasia to a flattening of the skull in the region of the anterior and middle fossae. Welcher's basal angle, formed by the intersection of a line extending from the nasion to the middle of the sella with a second line running from mid sella to basion, normally measures 130°. Anything above 140° constitutes a platybasia.

Basilar impression, on the other hand, concerns the posterior fossa and represents a relative elevation of the region of the foramen magnum, an invagination of C-1 and C-2 into the posterior fossa. It is a kyphos at the level of the occiput. Basilar impression is usually measured in terms of some arbitrary line, as for example Chamberlain's line, running from the opisthion to the edge of the hard palate. If the odontoid extends above, basilar impression is present. Other lines and angles have also been used but certain inherent difficulties in such methods have led the author to propose a "height index." For the base line, a modified Twinning line is drawn on the skull, connecting the tuberculum sellae with the highest point of the internal occipital eminence and specifically that point of the latter known as the arcuate eminence. The height index is the perpendicular distance from this line to the tip of the dens. The average height is 40–41 mm. Less than 30 mm. indicates basilar impression.

The first advantage of this method is that it portrays a true volume relationship of the posterior fossa. Other advantages include the fact that the dens and the tuberculo-cruciate line are on the same plane; that identification of the dens, tuberculum sellae, and the cruciate eminence is easy; that slightly inexact positioning for the lateral projection changes the index very little, and that it is not necessary to use laminagraphs. In only 1 case was the arcuate eminence so flat that it could not be exactly identified.

In 16 cases in which the author diagnosed basilar impression, the average height index was 26 mm. and the range was 22–29 mm. It is not to be considered that basilar impression could not have been diagnosed by other methods, but it should be noted that this index gives the precise indication of the depth of the posterior fossa. In these 16 cases, the basal angle of Welcher varied from 136 to 158°, indicating a concomitant platybasia. In 3 instances, "bathrocephaly" was associated. Klaus believes that there may be a causal relation ship between "bathrocephaly" and basilar impression. Fourteen of the 16 cases were classified as primary idiopathic and 2 as postrachitic.

Twenty figures, including 7 roentgenograms.

WILLIAM F. WANGNER, M.D.
Royal Oak, Mich.

Cerebral Metastases. Antonio F. Govoni and Bernard S. Epstein. Radiol. med., Milan **43:** 321–354, April 1957. (In Italian) (Long Island Jewish Hospital, New Hyde Park, New York)

This paper contains an extensive bibliographic review of cerebral metastases, including 475 titles. Twenty-four personal cases are briefly discussed, with the statement that in only 8 of these was a pineal shift noticeable on the routine roentgenograms. Pneumoencephalography, performed on 20 patients (of the 24), when "positive," showed only evidence of an "intracranial lesion" but was in no way characteristic. Nor was cerebral angiography, performed in 13 cases, pathognomonic. Only by a correlation between radiological and neurological findings is it possible to approach a tentative diagnosis, which will then have to be presented to the neurosurgeon for a decision in regard to operation (results are generally poor). Roentgen therapy is in the large majority of cases only palliative.

Fourteen roentgenograms, 5 tables.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Aneurysms on the Anterior Cerebral Artery: Evaluation of Surgical and "Conservative" Treatments. Carl H. H. Baumann and Paul C. Bucy. J.A.M.A. **163:** 1448–1454, April 20, 1957. (P. C. B., 250 E. Superior St., Chicago 11, Ill.)

The most common cause of spontaneous subarachnoid hemorrhage is ruptured intracranial aneurysm. About 25 per cent of all intracranial aneurysms involve the anterior cerebral system. Angiography is now thought to be a necessary prerequisite for intelligent management and proper treatment of intracranial hemorrhage following rupture of aneurysm.

An analysis is made of a series of 22 patients, 18 males and 4 females, personally treated by the authors. Those signs and symptoms indicating an unfavorable outcome include prolonged loss of consciousness, severe hemiparesis, papilledema, and to a lesser degree spinal fluid pressures above 330 mm. of water. In this series 7 patients received "conservative" management and without exception did poorly. Eleven patients underwent definitive surgical procedures and at least 9 of them did well. The remaining 4 had more conservative, less definitive, surgical treatment, with unimpressive results. Details concerning each patient in the series are given in tabular form. Technics for angiography were essentially those in general use. Without angiography, the surgical treatment of aneurysms would be limited to those localizing themselves by calcification or neurological signs.

Surgery must be individualized and carefully selected for each patient. In general, definitive surgery should be undertaken as soon as the patient's clinical condition warrants. Ligation of the proximal internal carotid artery is the treatment of choice for aneurysms below its bifurcation. Such treatment is seldom effective for aneurysms around the anterior communicating artery, and for these lesions the principal anterior cerebral artery supplying the aneurysm must be occluded. Whenever possible, the aneurysm should be removed, be excluded from the circulation, or have its neck clamped.

Conclusions are that "conservative management" is the most dangerous and least rewarding of any course of action. Whenever the patient's condition warrants, the most favorable approach is localization by angiography followed by early surgical intervention.

Three graphs; 1 table. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Secretory Sialography in Diseases of the Major Salivary Glands. Philip Rubin and John F. Holt. Am. J. Roentgenol. **77:** 575–598, April 1957. (P. R., National Cancer Institute, National Institutes of Health, Bethesda 14, Md.)

A series of 100 cases in which secretory sialography was done has been studied with a view to correlating the clinical, pathologic, and sialographic observations. Included were 25 cases classed as normal, 45 as inflammatory (24 chronic obstructive sialodochiectasis; 21 chronic nonobstructive sialectasis), and 30 as tumors (12 extrinsic; 18 intrinsic). Different media were employed, but the authors prefer Pantopaque. For both the parotid and submaxillary glands, postero-anterior and lateral films were obtained in the pre-injection and injection phases and five minutes after stimulation of the gland.

There appeared to be a fundamental difference between the pathogenesis of parotid and submaxillary gland swellings and the resultant sialographic pattern. Chronic infection of the submaxillary gland is usually associated with calculi, whereas parotitis is commonly nonobstructive. Calculi measuring less than 3 mm. in diameter do not obstruct. Larger calculi can act as ball-valves or be completely obstructing. Dilatation and pressure atrophy of the glandular parenchyma may occur progressively. Twenty per cent of submaxillary calculi and 40 per cent of parotid calculi are nonopaque. Strictures are a common cause of recurrent parotitis due to papillary duct obstruction or buccal mucositis. The former is usually caused by ill-fitting dentures; the latter is associated with masseter muscle hypertrophy.

Nonobstructive lesions are generally in the peripheral ducts and are classified in 4 stages: (1) punctate (early stage), (2) globular (moderately advanced stage), (3) cavitary (advanced stage), (4) destructive (end stage). The histologic pathology of the nonobstructing lesion correlates with the roentgen pattern of sparse, stenotic, interlobar and interlobular ducts, and dilated intralobular ducts. The secondary or emptying phase helps differentiate the types of nonobstructive diseases. Mikulicz's and Sjögren's syndromes are characterized by myoepithelial cell hyperplasia, which narrows the lumen of the interlobular ducts. There is markedly decreased salivary function in these cases, with little change in the appearance before and after emptying.

Tumors extrinsic to the salivary glands distort but do not obstruct, and emptying is complete. Intrinsic gland tumors show retention of contrast material. They are either encapsulated or invasive but there is no definite correlation with benignity and malignancy. Generally encapsulated intrinsic tumors displace the duct system but do not destroy it, whereas infiltrative tumors disrupt the gland architecture.

Cysts may sometimes be identified by their circumscribed appearance. There is little reaction in the secretory phase and occasionally one can aspirate and inject contrast material into the cyst cavity. Solid intrinsic tumors which cause little reaction in the smaller ducts with loss of secretory activity in the emptying phase are generally peripheral. Central tumors result in reaction in the larger ducts because of a ball valve-like mechanism whereby injection forces the medium past the obstructing point, but the pressure of secretion is not great enough to cause evacuation. Advanced infiltrative tumors result in complete loss of secretory function and the formation of bizarre patterns due to destruction.

Thirty-two roentgenograms; 4 photomicrographs; 4 drawings; 2 tables. PAUL MASSIK, M.D.
Quincy, Mass.

Swallowing Defects After Poliomyelitis. G. M. Ardran, F. H. Kemp, and C. Wegelius. Brit. J. Radiol. **30:** 169–189, April 1957. (G. M. A., Nuffield Institute for Medical Research, Oxford, England)

This is a report of cineradiographic studies on 8 patients who had difficulty in swallowing following bulbar poliomyelitis. The basic deficiency appeared to be inability of the pharynx to express its contents, due to weakness of the muscles controlling the lower end of the lateral food channels and failure of the mouth of the esophagus to relax. In an attempt to overcome their difficulty, the patients used all the means they retained to reduce the pharyngeal size to the smallest possible dimensions.

The authors indicate the potential hazards of aspiration, particularly as the patient is brought out of general anesthesia.

The article is well illustrated, with 22 figures, some containing as many as 12 sequential photographs. There is one table. HOWARD J. BARNHARD, M.D.
University of Arkansas Medical Center

Congenital Atresia of the Middle and External Ear. Andres Bustamante Gurria and Leo Deutsch. Arch. Otolaryng. **65:** 349–355, April 1957. (Medellin 94-3, México, D. F., México)

In the authors' opinion, three radiological projections are essential for the complete examination of congenital atresia of the middle and external ear: the lateral of Schüller, the transverse of Stenvers, and the axial of Mayer. Such x-ray studies not only provide the surgeon with preoperative data concerning the anatomical alterations which he will encounter but also give information about pathogenesis.

On the basis of the radiological and histologic findings, the authors distinguish two groups of atresias according to the state of the tympanic bone:

Group A. Hypoplasia of the tympanic bone
1. With substitution of the defect by
   (*a*) Hyperplastic styloid process
   (*b*) Excessively developed mastoid
   (*c*) Outgrowths formed from the squama
2. Without substitution of the defect

Group B. Hyperplasia of the tympanic bone

Fifty per cent of the authors' cases were of the so-called "pure" form, and the remainder of a "polymorphic" type.

The surgical treatment of congenital atresia of the ear is discussed. Final results depend largely upon pneumatization and the condition of the tympanic cavity.

Five roentgenograms; 2 drawings; 1 photograph; 5 audiograms.

THE CHEST

Recent Developments in Roentgen Examination of the Thorax. A. Zuppinger and L. Frank. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 419–431, April 1957. (In German) (Röntgeninstitut der Universität und des Inselspitals Bern, Bern, Switzerland)

A special positioning table marketed by Ing. W. Hofmann of Berne, Switzerland, and known as a Rotascop, is recommended to larger roentgen departments as an adjunct in the examination of the thorax. The table is double. The portion on which the patient lies has a built-in footboard, sideboards, elastic bolus blocks, and a head holder. This portion of the table swings through a 360° arc on the base portion, which corresponds to the ordinary fluoroscopic type in that it moves up and down from the perpendicular to the horizontal. By reason of the two ranges of motion, the patient can be placed in any horizontal and decubitus position, either right or left, and throughout this range of motion be examined either fluoroscopically or radiographically.

The usefulness of this device lies in the ease with which the various decubitus positions can be obtained. For example, the patient can be readily placed in either 90° right or 90° left decubitus. As a result of this, minimal pleural effusions have been demonstrated immediately following a negative report by routine methods. Should one find it necessary to differentiate a small effusion from an adhesion or diaphragmatic muscle bundles from adhesions, direct observation through the fluoroscope as the patient swings from the upright to a sideways position permits the correct diagnosis. An atypically located pleural effusion may be revealed by the same method. Other conditions in which study in various angulations is advisable include elevation of a leaf of the diaphragm, differentiation of atelectasis in association with a pleural effusion, the presence of underlying lung disease adjacent to a pleurisy.

For teaching purposes, the new table is useful in demonstrating respiratory mediastinal shift, the changes in diaphragmatic position and action with the patient lying on the side, variations in heart size and motions with change in position of the patient.

The Rotascop, in addition to the previously described applications, is routinely used for bronchography.

Nineteen figures, including 17 roentgenograms.

WILLIAM F. WANGNER, M.D.
Royal Oak, Mich.

The Diagnostic Significance, in the Sagittal Chest Film, of a Shift in the Upper and Middle Lobe Fissures. H. Ritter and M. Eyband. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 431–439, April 1957. (In German) (H. R., Hauptstrasse 21, Bitburg (Eifel), West Germany)

The minor interlobar fissure separates the right upper lobe, particularly its anterior segment, from the right middle lobe, largely its lateral segment. On the routine upright chest film, it may normally be seen in 70 per cent of adults and 76 per cent of children as a hairline across the right lung. Due to curvature of the minor interlobar space there may be a double line. On occasion, either a variation in the contour of the major interlobar fissure or the presence of an accessory lobe may mimic the normal minor lobar fissure, by being in a similar location. In most adults in full inspiration the right leaf of the diaphragm will project to the level of the tenth rib posteriorly. With the diaphragm at approximately this level, the minor fissure projects over either the seventh rib or the seventh intercostal space posteriorly and over the third intercostal space or the fourth rib anteriorly. In children, it tends to be a trifle higher. In the aged, due to senile kyphosis, it lies a little lower.

When the minor interlobar fissure is in an abnormal position on the plain film, it must be considered pathologic until proved otherwise. Most commonly a shift in position is due to a pure atelectasis, somewhat less frequently to atelectasis plus an infiltrate. In order to change the position of the fissure, the atelectasis must be relatively close by. Collapse above the level of the fissure elevates it; collapse below, whether in the lower lobe or in the middle lobe, tends to lower it. Changes high in the apex and low in the right lower lobe seldom influence the position of the fissure, largely because of intervening lung cushion. The change in position in some instances is a residual phenomenon from a previous atelectasis. At times, even after re-expansion of an atelectatic segment, there is no return to a normal position. Localized emphysema, regardless of its cause, has an opposite effect from atelectasis. An early pneumonia, sometimes even before the infiltrate is definitely visualized, influences the position of the fissure in a fashion similar to atelectasis. Due to change in lung elasticity, in deep inspiration a segment of lung involved by pneumonia is apt to be of lesser volume than normal. Without regard to specificity, tuberculosis has statistically an influence on the location of the interlobar fissure which is quite understandable when one considers the location and essential nature of the process. In 15 per cent of all adults with phthisis the fissure is elevated. Of tuberculous children, 3.3 per cent show an elevated interlobar fissure and 7.5 per cent a depressed fissure.

In any case in which, on a routine survey film, the interlobar fissure is noted to be outside of the average range, a complete work-up is indicated to make certain that no disease process is present.

Four roentgenograms.

WILLIAM F. WANGNER, M.D.
Royal Oak, Mich.

On Clear Bordered Images of the Left Apex. Joseph Jalet and Marcel Duplan. Dis. of Chest **31:** 462–464, April 1957. (Centre Medical M. G. E. N., Algiers, Algeria)

A patient with fibrous tuberculosis in the upper part of both lungs was treated with a right-sided extrapleural pneumothorax. Although he improved and his sputum was negative, tomograms revealed a rounded radiolucent area situated posteriorly at the left apex. No draining bronchus could be seen, but a cavity could not be excluded.

The authors then encountered a second patient in whom tomograms after the institution of a left-sided extrapleural pneumothorax revealed an identical

rounded radiolucent "lesion" in the left apex posteriorly. Since there was no lung or pleura in the left apex of this patient, the image was obviously not a cavity.

It is postulated that this image can represent a particular arrangement of apex ligaments or subclavian vessels; the thoracic duct might be the cause, but it is believed that an anomalous left azygos vein is the most probable explanation. This vessel drains the tenth to the third intercostal veins and then describes a gentle curve over the apex of the left lung as it courses anteriorly to the subclavian vein. When the lung is pulled away, a parietal mold of the vessel may remain to produce the image seen on the tomograms.

Six roentgenograms. LAWRENCE A. POST, M.D.
University of California, S. F.

Early Forms of Branched Pulmonary Ossification. E. Fischer. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 455–459, April 1957. (In German) (Röntgenabteilung der Chirurgischen Universitäts-Klinik, Tübingen, Germany)

Branched pulmonary ossification is a specific entity, consisting of a small, relatively localized calcific deposit within the lung parenchyma, resembling a portion of a branch of a tree with one or two twigs. Bone formation of this type is quite rare and is not to be confused with either tuberculosis or the nodular form of hemosiderosis. While the cause is unknown, the condition is probably metaplastic rather than inflammatory in origin.

The first cases of this type of ossification were described on a pathologic basis by Luschka (1856), who compared the formation to brain sand. A very rare diffuse form involving a large portion of the lung tissue is an exaggeration of the branch type. Fischer here reports a nodular form as a precursor of branch ossification.

The early stage consists of four or five small calcific nodules visualized in the roentgenogram as lying in a single line, possibly with a tendency toward branching. The resemblance to a string of pearls is quite striking. This early stage may be seen either in serial studies over the course of years or in patients with a more advanced process elsewhere in the lung. The small isolated calcifications will fuse, over a period of time, into a continuous piece of bone.

In some 35,000 sequential studies, 15 early cases corresponding to the above description and 1 fully developed case were found. The median age was fifty-five years, with males predominating and with the right lung favored as to location. The new formed bone is interalveolar and interlobular, thus lying within the connective tissue. It grows by reason of metaplasia of the adjacent tissue but, as the size increases, osteoblastic and osteoclastic action takes place to a point that a marrow cavity may develop. The patients are almost invariably asymptomatic.

Thus far the cause of branched pulmonary ossification is unknown. Chronic pneumonia, periarteritis nodosa, and other vascular calcifications have been considered as possibilities. The differential diagnosis includes tuberculosis, hemosiderosis, microlithiasis alveolaris pulmonum, histoplasmosis, pneumonoconiosis, calcified metastatic lesions, various artefacts, and iodized oil. Confusion should be negligible because the appearance is quite typical. When multiple small dense ossifications arranged in a row or as if on a branch of a tree are seen in the chest of an asymptomatic individual, the film plus the history should be diagnostic.

Seven roentgenograms.

WILLIAM F. WANGNER, M.D.
Royal Oak, Mich.

Observations on the Movements of the Trachea and Main Bronchi in Man. W. S. Holden and G. M. Ardran. J. Fac. Radiologists **8:** 267–275, April 1957. (Nuffield Institute for Medical Research, University of Oxford, Oxford, England)

Following routine bronchography, the authors used cineradiography to study the movements of the trachea and the main bronchi in man. Four hundred patients were examined by this technic. The appearances seen on breathing and coughing are described in detail and bronchovascular movements noted. The authors conclude that the changes in caliber throughout the trachea and main bronchi are passive and represent pressure effects. No evidence to support the peristaltic theory of smooth muscle contraction has been found during breathing and coughing. The function of bronchial smooth muscle is discussed and it is stated that the presence of smooth muscle in the bronchial tree renders it likely that muscle contraction may assist in the movement of mucus normally lining the tubes, particularly in the smaller bronchioles.

This article should be read in its entirety by those interested in this phase of physiology of respiration and the application of the cineradiographic technic to its study.

Forty-four roentgenograms; 1 chart.

THEODORE E. KEATS, M.D.
University of Missouri

Chronic Pulmonary Disease Associated with Beryllium Dust. George W. Chamberlin, W. Paul Jennings, and Jan Lieben. Pennsylvania M. J. **60:** 497–503, April 1957. (G. W. C., Reading Hospital, Reading, Penna.)

A series of 20 cases of chronic pulmonary disease with fibrosis is analyzed from the aspect of possible chronic berylliosis. All of the patients presented similar clinical findings consisting of anorexia, irritating nonproductive cough, weight loss, malaise, and increasing dyspnea, occasionally with pain in the chest. All appeared chronically ill. Chest roentgenograms also tended to be similar. In the early stages of berylliosis a finely granular pattern is present throughout the lung fields without visible nodules. With progression of the disease, the granular densities become larger and more irregular and are associated with small surrounding zones of alveolar emphysema. Further progression is accompanied by the development of frank parenchymal nodules, increasing emphysema, and scarring with fibrosis. Hilar shadows tend to be prominent, but apparently due to vascular congestion rather than nodes. In advanced cases cor pulmonale usually develops.

Of the authors' 20 patients, only 4 worked in an industry processing beryllium or its products. All of these responded well to cortisone. An additional 7 patients gave histories of varying degrees of exposure to beryllium dust: some cleaned the dusty clothing of persons who had worked in beryllium plants; others had resided in a neighborhood closely adjacent to a beryllium factory (Reading, Penna.). In this group there was a tendency to the more severe forms of the disease. Because of characteristic clinical findings and roentgen changes, the remaining 9 cases are

considered to be chronic berylliosis even though no known exposure to the element could be determined. In some instances tissue studies were available on patients of this "unknown exposure" group and varying amounts of beryllium element were identified in lung tissues by spectrographic methods.

Lung tissues from a control group of 13 consecutive unselected autopsies were similarly assayed for beryllium and almost without exception small amounts of the element could be demonstrated.

Conclusions are that a diagnosis of chronic pulmonary berylliosis can ordinarily be established on the basis of clinical and radiologic findings and that histology and chemical analysis of tissues will afford confirmatory evidence. Histologic studies ordinarily show fibrotic and granulomatous changes which are admittedly not specific for beryllium. It is evident from the finding of beryllium in lungs of asymptomatic individuals that the mere presence of the element is not enough to produce the disease and that there must be some "specific sensitivity" or some "trigger mechanism" to start the chain of degenerative fibrotic processes.

Four tables. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

THE HEART AND BLOOD VESSELS

The Syndrome of the Suspended Heart. William Evans and H. G. Lloyd-Thomas. Brit. Heart J. **19:** 153–158, April 1957. (Cardiac Department, London Hospital, London, England)

Thirteen patients are described in whom electrocardiographic changes appeared which were quite suggestive of myocardial infarction. The changes were not altered in the upright position, they were *not* accentuated by exercise, and, most important, a peculiar radiographic finding was observed in all cases. In the postero-anterior and left anterior oblique views in full inspiration there was unusual separation of the shadows of the inferior cardiac border and the diaphragm. The authors believe that the relative lack of contact of the heart with solid structures (air-containing lung) causes the impaired conduction reflected in the electrocardiogram. Clinically, none of the patients had other evidence of myocardial damage.

It is pointed out, in conclusion, that "recognition of the characteristic electrocardiographic and cardioscopic findings, featuring the syndrome of the *suspended heart*, should avoid the erroneous diagnosis of coronary arterial disease in subjects in whom chest pain is associated with a depression of the S-T segment in the electrocardiogram."

Six roentgenograms; 14 electrocardiograms.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Radiologic Evaluation of Cardiovascular Anomalies Producing Pulmonary Vascular Engorgement. E. F. Van Epps and L. L. Maher. J. Iowa State M. Soc. **47:** 187–191, April 1957. (Department of Radiology, State University of Iowa, Iowa City, Iowa)

Left-to-right shunts occur in atrial and ventricular septal defects and in patent ductus arteriosus, with or without pulmonary hypertension, and alone or in combination with other anomalies.

The authors have reviewed the complete records of patients at the State University of Iowa in whom cardiac catheterization during the year 1955 indicated a left-to-right shunt. This study reaffirmed both the usefulness and limitations of roentgen evaluation of cardiac anomalies. Left-to-right shunts are readily recognized unless the shunt is minimal or there are combined anomalies. Of all the lesions described, total anomalous venous return produces the only "characteristic" contour. The level of the shunt cannot be established with sufficient accuracy roentgenologically for complete reliance except in the case of patent ductus arteriosus demonstrated by retrograde aortography.

In general, angiography is of limited assistance in the evaluation of left-to-right shunts, and the authors prefer to localize an intracardiac shunt by cardiac catheterization, since with this procedure not only the site but also the volume of the shunt can be determined accurately. Pulmonary hypertension can be recognized from the alterations in the attenuation pattern of the pulmonary arteries.

Seventeen roentgenograms.

Calcification of the Left Atrium. Its Anatomic Location, Diagnostic Significance and Roentgenologic Demonstration. James J. Leonard, Sol Katz, and Donald Nelson. New England J. Med. **256:** 629–633, April 4, 1957. (District of Columbia General Hospital, Washington, D. C.)

Calcification of the left atrium may occur as a shell-like deposit in the subendocardial layer of the chamber or, less commonly, as a delicate laminated deposit in an intra-atrial thrombus. Either form of calcification can be easily missed on routine chest filming. Over-penetration or Bucky technics offer a better chance of demonstrating the process. Careful cardiac fluoroscopy will show a still larger percentage of atrial calcification, but even this method is not entirely reliable. In the authors' opinion the best method currently available for demonstration is carefully done tomography.

An analysis of previously reported cases of left atrial calcification indicates that the finding is diagnostic of long standing rheumatic carditis. Almost all cases will present mitral stenosis and the great majority will have associated mitral insufficiency of important degree. In addition, there is a high incidence of multiple valve disease. Because of the multiple valvular involvement and the usual prominent factor of mitral insufficiency, the finding of left atrial calcification represents a relative contraindication to surgery.

One case is presented in great detail. It had been long misdiagnosed as arteriosclerotic heart disease with hypertension, but subsequent events with follow-up to postmortem study showed extensive rheumatic carditis with calcification of the left atrium and mitral valve.

Seven roentgenograms; 1 photomicrograph; 2 photographs. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

The Aorta and Pulmonary Arteries in Fallot's Tetralogy. J. Norman Pattinson and Richard W. Emanuel. Brit. Heart J. **19:** 201–205, April 1957. (Middlesex Hospital, Middlesex, London, England)

From a study of angiocardiograms in 60 cases of Fallot's tetralogy the authors present some previously unrecorded observations on the aorta and pulmonary arteries.

The ascending aorta was constantly enlarged and a narrowing occurred rather abruptly just beyond the origin of the left subclavian. The ascending and

descending limbs were more widely separated than normal, provided the arch was left-sided. In subjects with a right-sided arch the aorta crossed to the left of the midline in the lower third of the thorax.

Six patients (14 per cent) showed an anomalous right subclavian artery as the last branch of the arch, crossing behind the esophagus (compared to an incidence of 0.7 per cent in those without Fallot's tetralogy).

In 19 of the 60 cases one pulmonary artery was larger than the other—17 left and 2 right. No difference in lung opacity in the two sides could be detected when the arteries were asymmetrical.

Nine drawings. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Traumatic Cardiac Aneurysm; Calcified Cardiac Aneurysm. A. Vogt. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 439–447, April 1957. (In German) (Kaiserstrasse 58, Frankfurt a. M., Germany)

In the diagnosis of ventricular aneurysm a roentgen kymogram is essential. Small aneurysms can seldom be seen fluoroscopically. Even the larger ones may be invisible in the presence of heart failure because of small amplitude of pulsations. With either the step kymogram or the plain kymogram the demonstration is relatively easy. The typical kymographic finding consists of a systolic outward movement of the ventricular wall in the region of the aneurysm.

Two cases are described in which the diagnosis depended upon the roentgen studies because the electrocardiograms were entirely normal. The first case resulted from a shrapnel fragment embedded in the left ventricular wall. In this case the frames of the kymogram corresponding to the position of the metal splinter exhibited paradoxical pulsation. No calcific content was demonstrable. The second patient was a man who had suffered a myocardial infarction fifteen years prior to the present study. The kymogram demonstrated flattened waves adjacent to a thin shell of calcium in the heart wall. Again the electrocardiogram was negative. In this instance the diagnosis was confirmed by postmortem studies following death from lymphatic leukemia.

Three roentgenograms; 9 kymograms; 2 photographs; 1 drawing. WILLIAM F. WANGNER, M.D.
Royal Oak, Mich.

Lieno-Portal Venography in the Study of Portal Circulation in the Dog. I. Bergstrand and C.-A. Ekman. Acta radiol. **47:** 257–268, April 1957. (University Hospital, Lund, Sweden)

The commonly accepted signs of portal obstruction on lienoportal roentgenograms are: (1) filling of collaterals, (2) a retarding of the flow of the contrast medium, and (3) widening of the splenic and portal veins. To determine whether factors other than portal obstruction might be capable of producing these roentgenographic changes, the authors studied the lienoportal circulation in 19 dogs by means of venograms under normal and controlled experimental conditions.

Variations in the rate of injection of the contrast medium into the spleen produced no changes in portal pressure or film appearances, as judged by the presence or absence of collaterals, variation in width of the splenic vein, or the velocity of flow of the contrast medium.

Injection of the contrast medium into the splenic vein was followed by hemodynamic changes in the portal system.

No changes were noted following ligation of the splenic artery.

Complete obstruction following ligation of the portal vein resulted in a temporary increase in portal pressure of 8 to 53 cm. (mean of 29 cm.) H_2O. After thirty to sixty minutes the increase diminished.

As a rule no filling of the portal vein was noted next to the site of its complete obstruction.

In portal stasis, the vessels were increased in width, velocity of flow was decreased, and collaterals were usually demonstrable.

Because of the relatively high specific gravity of the contrast medium, its distribution in the intrahepatic portal branches varied with position of the animal.

From the observations recorded above, the essayists conclude that:

(1) No increase in portal pressure is detectable when contrast media is injected into the spleen because this structure absorbs the rise in pressure.

(2) Lienoportal venography is a reliable method for judging the direction of flow of the portal blood, the velocity of portal flow, and the width of the splenic vein, but the method is not dependable for demonstrating so-called "streamlining" and the distribution of the portal blood in the liver.

(3) The changes demonstrated in portal obstruction are due entirely to pathologic circulatory changes.

(4) The lienoportal venogram will not always show the site of portal obstruction.

(5) The collaterals drain the blood in portal obstruction.

(6) Increase in abdominal pressure—such as noted in ascites—may produce narrowing of the splenic vein, probably because of mechanical pressure.

Eight roentgenograms; 1 table.

H. C. JONES, M.D.
Grand Rapids, Mich.

Percutaneous Lieno-Portal Venography. Technique and Complications. I. Bergstrand and C.-A. Ekman. Acta radiol. **47:** 269–280, April 1957. (University Hospital, Lund, Sweden)

Opacification of the portal system by contrast material may be done by direct injection of the portal tributary at laparotomy, by introduction of the medium into the splenic parenchyma after percutaneous injection, by percutaneous puncture of a large portal branch near the hilus of the liver, by introduction of the contrast medium into the arterial side, with delayed films (as in abdominal aortography), or by catheterization of the celiac artery.

Percutaneous lienoportal venography has been most widely used. The authors describe their technic and results in 175 examinations on 128 patients.

The most common indication for the procedure is the investigation of probable portal hypertension. It has also been found useful in evaluation of tumors of the liver and pancreas. Approximately 30 c.c. injected into the spleen is an adequate dose in the adult.

If all of the contrast material is injected into the spleen, the patient has a sensation of warmth or burning during injection which is localized to the organs perfused with the medium. Pain in the left side or left shoulder during and after the injection was uncommon except when the injected material was deposited extralienally. In 4 of the 175 examinations there were signs of shock and abdominal pain suggesting intra-abdominal hemorrhage. The risk of hemorrhage did

not appear to vary with the size of the spleen or with the prothrombin index.

It was felt that approximately 25 exposures with an automatic film-changing device were helpful in providing the most information from the examination.

It is concluded by the authors that percutaneous lienoportal venography with the technic described gives valuable information on the morphology and hemodynamics of the portal system without undue risk of serious complication.

J. A. GUNN, M.D.
Grand Rapids, Mich.

Percutaneous Trans-splenic Portal Venography: Applications and Hazards. E. Robert Heitzman, Jr., and Leo G. Rigler. California Med. **86:** 229–234, April 1957. (L. G. R., Cedars of Lebanon Hospital, 4833 Fountain Ave., Los Angeles 29, Calif.)

The authors present observations on percutaneous trans-splenic portal venography. The number of examinations forming the basis of these observations is not given.

In all cases splenic puncture was done immediately preceding a planned operation, and in most patients under a general anesthetic. It was found desirable to introduce the needle during expiration in order to reduce the possibility of accidental pulmonary trauma. A 3-inch 20-gauge spinal needle was inserted through the left 9th or 10th intercostal space in the midaxillary line. Definite resistance was felt as the spleen was first encountered. After an additional advance of 2 to 3 cm. a successful puncture was indicated by aspiration of a small quantity of blood. Twenty cubic centimeters of 70 per cent Urokon was then injected as rapidly as possible and serial films of the upper abdomen were obtained at one-second intervals.

In patients not anesthetized, considerable transient pain followed the injection. In one case where all the contrast medium was, by accident, injected into the peritoneal cavity, there was relatively little pain. About half the patients experienced a temporary fall in blood pressure. With one exception, hemorrhage at the site of puncture was found to be insignificant when the patient was seen by the surgeon a few hours after injection. In the exceptional case there was active oozing from an 8-mm. laceration of the spleen, with about 500 c.c. of blood in the peritoneal cavity, presumably due to respiratory motion at the time of injection. The authors emphasize that in many patients in whom portacaval or splenorenal shunts are contemplated there may be factors which predispose to bleeding.

The indication for the examination is evaluation of the anatomy of the portal circulation in order to determine the best surgical approach to correct portal hypertension. Knowledge of the size and patency of the veins is essential, and demonstration of major collaterals may be helpful. Estimation of portal pressure is mentioned, but no criteria are given; however, in those patients with high portal pressures, considerable retrograde filling of the inferior mesenteric vein was noted. The authors state that this procedure should also be useful to study the gross structure of the liver and to gain more information in other conditions, including carcinoma of the body of the pancreas and pancreatic cyst.

Eleven roentgenograms.

LAWRENCE A. POST, M.D.
University of California, S. F.

The Usefulness and Limitations of Percutaneous Splenoportography. H. Anacker, K. Devens, and G. Linden. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 411–419, April 1957. (In German) (Justus-Liebig-Hochschule, Giessen, Germany)

Because of fear of complications, splenoportography has received little acceptance in Germany. It is now necessary to weigh the advantages against the disadvantages of this procedure because this is the only practical method of diagnosing portal thrombosis. To perform the test, a long needle is inserted between the ribs into the spleen and 40 c.c. of an aqueous contrast medium is injected under moderate pressure. Ordinarily this will reach the liver in 2.5 to 4 seconds, but in the presence of portal thrombosis and of some other diseases, the time is prolonged to ten or more seconds. With a serial shift device, four or more exposures are obtained, beginning one second after injection. Enlargement of the lienal and of the portal vein is readily seen when a thrombosis is present. Shortly thereafter, the dilated abdominal veins and later the tortuous thoracic veins, can be seen. The collaterals may attain an amazing size. Submucosal varicosities in the stomach produce a pattern closely resembling the rugae as seen on barium swallow. Esophageal varices can be readily demonstrated.

Advanced cirrhosis provides a similar pattern, a slowing of the circulation time of the medium, stasis in the afferent veins, and dilated collaterals. The portal vein can be visualized in the liver, but there is apt to be a paucity of secondary ramifications within that organ.

Attempts have been made to utilize splenoportography to establish the patency of a portocaval shunt, to determine the presence of liver metastases with known tumor of the stomach, and to outline pancreatic tumors. These efforts have not been particularly successful.

The complication most to be feared in this examination is hemorrhage. The bleeding may be immediate or delayed, and may be followed by rupture of the spleen. Hematomas of up to 1,500 c.c. have been found on surgery. It is this hemorrhagic hazard that gives the procedure a mortality of slightly more than 1 per cent. The chief reason for bleeding lies in the respiratory movement which converts the puncture hole in the spleen into a slit. In the authors' opinion, the only good answer to this is never to perform splenoportography except on a patient from whom the spleen may safely be removed and when provision for immediate surgery has been arranged. In addition, the trauma to the spleen should be minimized by having the patient under intratracheal anesthesia, with respiratory excursion reduced to a minimum during the period of time in which the needle is inserted.

Eleven roentgenograms.

WILLIAM F. WANGNER, M.D.
Royal Oak, Mich.

Splenoportagraphy in Portal Hypertension: Its Value in Selecting the Operative Procedure of Choice. William P. Mikkelsen and Arthur C. Pattison. California Med. **86:** 235–241, April 1957. (W. P. M., 1930 Wilshire Blvd., Los Angeles 57, Calif.)

Splenoportography is an almost indispensable adjunct to the surgical management of portal hypertension, delineating the anatomy of the portal system and thus determining the operative procedure most likely to succeed. Because the authors encountered signifi-

cant hemorrhage following percutaneous injection of the spleen, they now inject contrast medium into the spleen only after opening the abdomen. An initial transverse incision is extended to the left or right, depending on the type of procedure to be done.

When the cause of portal hypertension lies within the liver and the portal venous system is patent, a portocaval shunt is usually the operation of choice. However, if the patient has significant hypersplenism, it may be desirable to perform a splenectomy and splenorenal anastomosis. The efficiency of any venous shunt in eliminating portal hypertension depends to a great extent on the size of the afferent vessel and the size of the anastomosis, so that one must weigh several factors, including the size of the vessels on the roentgenograms, degree of hypersplenism, and the threat of hemorrhage from esophagogastric varices.

Splenoportography finds its greatest value in cases of extrahepatic obstruction. If the portal and superior mesenteric veins or portal vein alone are occluded, a splenorenal shunt must be done. Obstruction of only the splenic vein may have to be confirmed by a secondary portogram *via* a jejunal mesenteric vein to show patency of the superior mesenteric and portal veins. In this situation, splenectomy alone will control bleeding varices. If all the major veins of the portal system are occluded, no type of veno-venous shunt is possible, and one must operate directly on the varices. There are three procedures available: segmental esophagogastrectomy, transesophageal ligation of the varices, and portal azygos disconnection by transection and resuture of the gastric cardia. Splenectomy may be done as an adjunct to any of these procedures. At present, the authors prefer portal azygos disconnection; since vagotomy is technically unavoidable, pyloroplasty is also done to assist gastric drainage. Their experience with this operation is limited to two recent satisfactory results.

Ten roentgenograms; 4 diagrams.

LAWRENCE A. POST, M.D.
University of California, S. F.

Current Problems in Management of Patients with Portal Hypertension. Charles G. Child, III, and Arthur J. Donovan. J.A.M.A. **163:** 1219–1228, April 6, 1957. (C. G. C., III, 818 Harrison Ave., Boston 18, Mass.)

Problems Common to Extrahepatic and Intrahepatic Block: In patients with severe hemorrhage from varices autopsy has shown frank ulceration in about 50 per cent; in 40 per cent there appears to be a clean tear, as though the varix had ruptured mechanically; and in the remaining 10 per cent a site of hemorrhage cannot be demonstrated. Identification of the precipitating factor is a problem common to extra- and intrahepatic block.

A second problem concerns the importance of portal hypertension itself. Many believe it is without deleterious effects. There is the possibility that elevated portal pressure may interfere with absorption of nutriment from the gastrointestinal tract. In cirrhosis high portal pressure may compromise normal hepatocellular function, but patients with extrahepatic block are generally regarded to be in good nutritional state. From this the inference is drawn that portal hypertension *per se* is innocuous, but the possibility that it may be harmful cannot be ignored.

Among patients with extrahepatic block, hemorrhage may be controlled by tamponade or it may cease spontaneously. Once this has occurred there is a prompt return to a state of relatively good health. In patients with cirrhosis, however, hemorrhage is notoriously difficult to control and is all too frequently followed by deepening jaundice, ascites, and even coma. No agreement exists as to the best method for stopping variceal hemorrhage. Some believe that the bleeding varices can be controlled by tamponade; others believe that tamponade should be considered only a means of stopping hemorrhage while the patient is being prepared for immediate ligation of the bleeding varix; and others have suggested that a portacaval shunt may be done as an urgent procedure. Still others believe that division and suture of the stomach and its attached vascular ligaments will successfully exclude the dilated and bleeding varices from the hypertensive and hypervolemic portal bed.

Portal Hypertension Due to Portal Venous Thrombosis: Portal thrombosis is usually seen in children or young adults who had had unheralded variceal hemorrhage or have anemia and an enlarged spleen. Ideal treatment consists of splenectomy and portal decompression by means of an end-to-side splenorenal shunt. Success in controlling hemorrhage is dependent on a patent communication between the splenic and the coronary veins.

When a shunt is out of the question, a logical operation is limited esophagogastrectomy, leaving the stomach in place and re-establishing esophagoenteric continuity by means of a Roux-en-Y esophagojejunostomy. By the use of this procedure an effort is made to provide protection to the patient from hemorrhage even though the varices recur. A small percentage of these young people with variceal hemorrhage will be found to have a form of juvenile cirrhosis. In such patients portal venography is useful.

Portal Hypertension Secondary to Cirrhosis of the Liver: In patients with cirrhosis, recurrent hemorrhage can be prevented by portal decompression. Portal decompression is considered potentially useful in patients with cirrhosis who have survived one or more hemorrhages, those with known varices which have not bled, and those in relatively good health whose primary problem is ascites that is not controlled by restriction of salt and by dietary measures. The decision for portal decompression surgery depends on the assumption that once the patient has bled from his varices, he is likely to do so again and, second, that nonsurgical measures are of no avail.

Portal Decompression for Ascites: Generally, the use of portal decompression for ascites has been rather discouraging. It might be considered in patients whose collections of abdominal fluid do not subside within a reasonable time on a restricted sodium intake and who are otherwise in reasonably good health. Some favorable results in such cases have been reported.

Neuronutritional Deficits in Patients with Cirrhosis: Varying degrees of coma have been recognized as a serious complication of advanced hepatic disease. That this neurological deficit may be precipitated by massive esophagogastric hemorrhage is well known. It has been demonstrated that this type of stupor bears a more or less direct relationship to elevated concentration of ammonia in the blood. This has been correlated with a characteristically abnormal electroencephalo-

graphic pattern. These observations, together with knowledge of meat intoxication in dog and man after an Eck fistula, have led to speculations on the possible adverse neuronutritional effects of shunting the portal blood of a patient with advanced liver disease into his systemic circuit.

Hepatic coma has been classified into two types; first, spontaneous encephalopathy, represented by patients in hepatic failure in whom an elevated level of ammonia in the blood is but one of a number of poorly understood metabolic disorders; second, exogenous hepatic coma, in which ammonia intoxication is proposed as the sole cause.

Type of Shunt for Control of Esophagogastric Hemorrhage: Hemodynamically there are two types of shunt. The first includes the end-to-side splenorenal, the side-to-side portacaval, and the end-to-side caval-superior mesenteric. The second is the end-to-side portacaval shunt. A splenorenal or side-to-side portacaval shunt is more desirable than an end-to-side portacaval anastomosis, because it permits a certain increment of portal blood to gain access to the liver. The incidence of adverse effects upon the liver is less than it is when the liver is deprived of portal blood. Apparently all the facts about postportal decompression dynamics are not known, and the authors suggest that it is improper to assume that portal blood will pass through the liver just because a side-to-side portacaval or splenorenal shunt exists. Whether draining hepatic arterial blood out of the liver in two directions at once is beneficial or harmful is not established. As cirrhosis develops, hepatic arterial portal venous shunts increase in number until the liver, in effect, becomes the site of innumerable arterial portal venous fistulas.

End-to-side portacaval shunt is generally considered to be more effective in preventing recurrent hemorrhage. The lesser success of the splenorenal shunt is attributed to greater technical difficulties encountered in fashioning the shunt itself; in addition, it has been suggested that during a remission of the patient's cirrhosis the demand upon the splenorenal or side-to-side portacaval shunt may be lessened and the shunt will shrink appreciably. With cirrhotic recrudescence such a shunt might prove inadequate. The authors' experience does not support another criticism of the end-to-side portacaval shunt, that is, its failure to relieve an associated hypersplenism. The average congested spleen shrinks remarkably in size within a few months after the shunt is opened.

In summary, the authors have discussed the many unanswered problems relating to the management of patients with portal hypertension. They stress the need for a controlled study of these various problems; the precipitating factors in variceal hemorrhage need to be identified; whether portal hypertension is in itself deleterious to the patient has not been defined. The best operation for patients with extrahepatic block to whom a shunt is unavailable remains undetermined. The probability of hemorrhage and death among patients with varices who have and have not bled is not known. Such information would be highly desirable for patients who have bled but is even more essential in deciding as to the necessity of portal decompression in patients who have not bled.

Five roentgenograms; 3 diagrams; 1 chart.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

THE DIGESTIVE SYSTEM

The Picture of the Esophagus in Typical Changes in Form and Position. J. Eberl. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 447–455, April 1957. (In German) (Institut und Poliklinik für Physikalische Therapie und Röntgenologie der Universität München, Ziemssenstrasse 1, Munich 15, Germany)

The empty, pliable, freely movable esophagus acts as a sensitive indicator of disease processes in the adjacent mediastinum. Such processes, particularly when vascular, may alter the esophagus in contour and position, and may disturb its function. The author is particularly concerned, in this article, with the special instances of blood vessels crossing the esophagus transversely or obliquely. In general, the two oblique views will catch most abnormalities. At times the patient must be rotated under fluoroscopic control through a full 180° for complete clarification. A relatively small blood vessel transversely crossing the esophagus produces a local filling defect with some narrowing of the lumen and with modest interference with deglutition. Larger vessels and those cutting the esophagus obliquely will produce a more generalized displacement, with or without associated disturbance in function. The typical differential diagnosis lies between a vascular lesion and an extraesophageal tumor. Among vascular defects which come into consideration, particularly in the upper portion of the esophagus, are the double aortic arch, the persistent duct of Botalli, and the retro-esophageal subclavian artery. Careful study with thick barium in the esophagus suffices in most instances for a correct diagnosis.

Fourteen figures, including 7 roentgenograms.

WILLIAM F. WANGNER, M.D.
Royal Oak, Mich.

The Roentgenologic Diagnosis of Esophageal Varices. Sidney W. Nelson. Am. J. Roentgenol. **77:** 599–611, April 1957. (Ohio State University, Columbus 10, Ohio)

Accuracy in the diagnosis of esophageal varices calls for certain special technics, including measures to delay the passage of barium, to increase the adherence of barium, to decrease peristalsis, and to increase venous pressure. Some of the means employed to accomplish these ends are examination in the recumbent and Trendelenburg positions, the use of a thick barium, or the addition to ordinary barium of 0.25–0.75 per cent carboxymethyl cellulose, the subcutaneous injection of 0.5–10 mg. of atropine sulfate thirty minutes before the examination, and the appropriate use of the Valsalva maneuver. Fluoroscopically controlled spot-filming during visible filling of the varices or at optimum times during various maneuvers designed to demonstrate the less obvious cases will give the highest percentage of diagnoses. Gastric varices should always be sought when esophageal varices are suspected.

Fifty-seven roentgenograms; 1 drawing.

PAUL MASSIK, M.D.
Quincy, Mass.

Early Diagnosis in Massive Upper Gastrointestinal Bleeding. Irving B. Brick. J.A.M.A. **163:** 1217–1219, April 6, 1957. (3800 Reservoir Rd., N. W., Washington 7, D. C.)

The author stresses that as much diagnostic informa-

tion as possible should be obtained before instituting treatment for massive upper gastrointestinal bleeding. While peptic ulcer of the duodenum and stomach (70 per cent) and esophageal varices (10 to 15 per cent) are most frequently responsible, many other diverse causes have been found. The value of complete history and physical examination in arriving at the exact etiology is stressed.

Previous confirmed history of peptic ulcer or recurrent hemorrhage suggests the presence of peptic ulcer. A history of liver disease, jaundice, ascites, or edema may suggest esophageal varices. The presence or absence of pain may not be specifically helpful, since in many cases with peptic ulcer pain disappears when the hemorrhage begins. A long history of recurrent pain, however, is more indicative of peptic ulcer than of carcinoma of the stomach. Dysphagia, regurgitation, and pyrosis prior to bleeding may point to the esophagus as a site of disease.

Drugs such as salicylates, the steroids, and such preparations as prednisone have been recorded as being probable causative factors in gastrointestinal bleeding. It is not clear whether these substances lead to ulceration or whether they exacerbate pre-existing ulceration by stimulating secretion of acid and pepsin. Bleeding due to phenylbutazone, the anticoagulant drugs, and Reserpine has been reported.

A history of alcoholism may suggest cirrhosis and esophageal varices as well as the possibility of acute gastritis and the Mallory-Weiss syndrome. Central nervous system operations, acute poliomyelitis, and severe external burns may also be associated with ulceration and bleeding. A family history of prolonged bleeding with reference to either the gastrointestinal tract or other systems may suggest the possibility of hereditary hemorrhagic telangiectasia.

Bleeding is the only manifestation of peptic ulcer in about 15 to 20 per cent of patients. Pain may be absent. The physical examination provides many helpful clues to the presence of cirrhosis and esophageal varices. The findings include spider nevi, jaundice, ascites, hepatosplenomegaly and abdominal venous pattern, and telangiectasia, this last also suggesting hereditary hemorrhagic telangiectasia. The finding of melanin pigmentation about the lips and buccal mucosa may suggest intestinal polyposis. The presence of enlarged lymph nodes in the left supraclavicular area or the finding of Blumer's shelf is suggestive of a gastrointestinal neoplasm.

At times, laboratory data may be helpful in distinguishing the cause of bleeding. Leukemia may be diagnosed by blood smear. It has been suggested that retention of over 15 per cent of sulfobromophthalein usually means bleeding from esophageal varices. However, anoxia resulting from massive blood loss may cause abnormal retention in a patient whose liver is quite normal.

X-ray examination in the patient with gastrointestinal bleeding may be done safely within twenty-four to forty-eight hours of the acute bleeding episode. Unless the examination is performed rather promptly, the lesion may be completely missed due to healing. For proper examination it is essential that the stomach be empty of secretions and blood clots. This can best be accomplished by the use of a lavage tube of wide diameter and either ice water or lukewarm water. Such lavage may also cause temporary cessation of bleeding.

If the x-ray examination does not provide a diagnosis, endoscopy is indicated, particularly in the patient who continues to bleed. The importance of negative esophagoscopy is of value in the case in which bleeding continues. Even when the diagnosis is not definite, consideration of surgery, usually a subtotal gastric resection, is important. Since massive upper gastrointestinal hemorrhage means that blood is coming from the duodenum, stomach, or esophagus, blind subtotal gastric resection is the correct procedure.

The author concludes that the use of all methods of study, including history, physical examination, laboratory studies, and x-ray and endoscopic examinations have their place in the early diagnosis of massive upper gastrointestinal bleeding. The most definitive information will be obtained by x-ray and endoscopic examinations.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Personal Experience with Gastric Parietography. M. Dardari and G. C. Canossi. Ann. radiol. diag. **30**: 33–49, 1957. (In Italian) (Istituto di Radiologia dell'Università di Modena, Modena, Italy)

"Gastric parietography" is body-section roentgenography following artificial (diagnostic) pneumoperitoneum and gastric insufflation. Of the 6 illustrative cases presented (which had also the usual barium studies), 5 were malignant infiltrative processes in the gastric wall, proved by surgical exploration. The sixth patient had a niche (which subsequently disappeared under medical management) demonstrated by parietography, where the conventional studies had suggested an infiltrative lesion.

Gastric parietography is regarded by the authors as a useful adjunct in the evaluation of certain cases, particularly when infiltrative lesions of the gastric wall are suspected.

Seventeen roentgenograms.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

A Roentgenologic Study of Ulcerating Lesions of the Stomach. Gladden V. Elliott, Stanley M. Wald, and Richard I. Benz. Am. J. Roentgenol. **77**: 612–622, April 1957. (R. I. B., 510 South Kingshighway, St. Louis 10, Mo.)

This study is based upon all cases of histologically proved, roentgenologically detectable ulcerating lesions of the stomach examined at the Mallinckrodt Institute of Radiology (St. Louis) between 1947 and 1955. There were available for review 191 such cases. Ninety patients had giant ulcers (more than 2.5 cm. in diameter), or ulcers located in the prepyloric region or on the greater curvature. These are the principal considerations in the present report.

Of 12 greater curvature ulcers, 6 were benign. The accuracy of diagnosis in this group was 75 per cent. There were 49 giant ulcers, of which 31 were benign. The accuracy of diagnosis here was 80 per cent. Of 37 prepyloric ulcers (within 2.5 cm. of the pylorus), 29 were benign. The accuracy of diagnosis in this location was 78 per cent. The overall accuracy for the 90 cases was 80 per cent. In the 101 cases which did not fall into the above special categories, the diagnostic error was 12 per cent; 49 of the tumors were benign.

The diagnosis of benign ulcers is generally more accurate than of malignant ulcers and is roughly comparable for both the special categories and the 101 remaining cases. Accuracy of diagnosis was less in the malig-

nant cases in the three special categories because of the customary tendency to diagnose as malignant ulcers on the greater curvature, giant ulcers, and those in the prepyloric area. The criteria for benignity are: (1) projection of the ulcer crater beyond the apparent gastric margin, (2) absence of an irregular filling defect or infiltration about the crater, (3) radiation of mucosal folds toward the ulcer, (4) presence of overhanging edges, and (5) regularity of the ulcer niche.

The authors conclude that the size and location of an ulcer are of no diagnostic significance.

Twenty-four roentgenograms; 5 tables.

PAUL MASSIK, M.D.
Quincy, Mass.

Multiple Chronic Gastric Ulcers. Report of a Case with Four Simultaneous Ulcers. Isadore Katz and Marvin L. Bierenbaum. Am. J. Roentgenol. **77:** 623–626, April 1957. (I. K., VA Hospital, Brooklyn 9, N. Y.)

The authors report a case of multiple gastric ulcers and review the literature. Their patient was a 60-year-old male with four simultaneous benign gastric ulcers. He was treated by gastrectomy and was later reported to be asymptomatic.

In the previously recorded cases, the number of ulcers varied from 2 to 22 (in one unusual case). The incidence was from 2 to 10 per cent in series from institutions with large numbers of cases. Most of the ulcers were benign.

Two roentgenograms: 1 photograph.

PAUL MASSIK, M.D.
Quincy, Mass.

Acute Volvulus of the Stomach Emphasizing Management Hazards. A. A. de Lorimier and Lloyd Penn. Am. J. Roentgenol. **77:** 627–633, April 1957. (A. A. de L., 33 Mountain Spring Ave., San Francisco 14, Calif.)

The authors present a discussion of acute volvulus of the stomach and report an illustrative case.

Acute volvulus of the stomach is a condition of some rarity which may constitute a surgical emergency. The case reported here had the following typical features: ingestion of a large meal followed by abdominal distention, retching, and inability to vomit; development of constricting epigastric pain; aching in the back. The roentgenologic "criteria" are localized massive distention of the upper abdomen; visualization of a "hairpin loop" with incisura directed toward the right upper quadrant or posteriorly; fixation of the loop regardless of positioning of the patient; delimitation of ingested barium at the tapering extremity of the esophagus; anterior or inferior displacement of the spleen; and segmental distention of loops of small bowel and colon as evidence of an adynamic ileus.

Differential diagnosis is primarily concerned with the following conditions: (1) gastric atony, (2) intestinal obstruction, (3) sigmoid and cecal volvulus, (4) acute pancreatitis, and (5) ruptured peptic ulcer.

The author's experience in this case warrants comment on the management of acute volvulus. His patient followed common procedure and ingested baking soda for relief of gastric distress. This resulted in distention of an existing hiatal hernia and possibly provided the initial twisting which prevented the stomach's efforts to empty itself. The patient received 300 mg. Demerol in six hours plus $^1/_6$ gr. morphine sulphate without effect. This over-sedation is believed to have been a contributing factor in the patient's death upon sudden release of the distended viscus. Counteraction of the sedative is recommended before relief of the tension.

Ulceration in the distal esophagus was noted upon postmortem examination and is believed to have been caused by repeated efforts to pass a gastric tube. This practice is considered hazardous and responsible for unnecessary delay in treatment. Prompt surgical relief is urged with assistance by a medical anesthetist in respect to pharmacologic and fluid balance requirements.

Five roentgenograms. NORMAN L. ARNETT, M.D.
Upland, Calif.

Adult Hypertrophy of the Pylorus. A. M. Desmond and B. F. Swynnerton. Brit. M. J. **1:** 968–971, April 27, 1957. (St. James' Hospital, London, England)

Report is made of 25 cases of pyloric hypertrophy in adults found at surgery during a ten-year period. All of the patients presented similar histories, suggesting gastric or duodenal ulcer. Vomiting was frequently a prominent symptom and in several instances had been intermittent for years. Physical signs were not usually helpful but all patients showed some degree of epigastric tenderness.

Radiologic findings resulted in a definite diagnosis of hypertrophic pyloric stenosis in only 1 instance. Elongation or narrowing of the pylorus was not a prominent finding. An "umbrella defect" at the base of the duodenal bulb was occasionally noted. Most cases were diagnosed as duodenal or pyloric ulcer with pyloric delay.

At surgery, 18 peptic ulcers were found—11 gastric and 7 duodenal. The rounded, smooth, firm hypertrophied pylorus was usually obvious, and differentiation from carcinoma was not felt to be difficult. In a few instances biopsy was done.

Pyloric hypertrophy in adults seems to have no connection with the similar disease occurring in infancy. None of the authors' patients had had pyloric stenosis in infancy, although a few complained of intermittent cyclic episodes of vomiting during childhood. It appears that there must be some association with peptic ulcer, in that the majority of the patients have had duodenal or gastric ulcer.

A note as to management suggests partial gastrectomy if peptic ulcer is associated. Where no associated lesion is found (about 7 cases in this series) a pyloroduodenotomy with pyloroplasty is suggested.

Data from the 25 reported cases are summarized in an extensive table.

[Roentgenograms of the small "spot-film" type are reproduced but are not very helpful. Most of them seem to have been reproduced upside down. J. W. B.]

Seven roentgenograms; 1 photograph; 1 table.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Duodenal Involvement in Regional Enteritis. Theodore E. Keats and Rita M. Brady. Am. J. Roentgenol. **77:** 639–643, April 1957. (R. M. B., University of California Medical Center, Department of Radiology, San Francisco 22, Calif.)

Three cases of regional enteritis involving the duodenum are presented and the authors suggest that such involvement is not as rare as the literature would indicate.

In the cases reported the clinical findings are not significantly different than those of regional enteritis elsewhere in the intestinal tract. The only notable difference is the occurrence of nausea and vomiting in two of the cases, usually not an important observation in regional enteritis unless there is obstruction. These symptoms are taken as an indication of involvement of proximal small intestine.

The roentgen findings of regional enteritis in the duodenum do not differ from those associated with involvement of other portions of the small intestine. Changes are those associated with inflammation; namely blunting, thickening, and irregularity of the mucosal folds. The mucosa may assume a polypoid appearance as the disease progresses, due to the presence of islands of hyperplastic mucosa. In the late stages the intestines become scarred and stenotic.

Isolated involvement of the duodenum presents a difficult diagnostic problem. In such cases peptic duodenitis, lymphosarcoma and carcinoma of the duodenum, carcinoma of the ampulla of Vater, carcinoma of the pancreas with duodenal invasion, pancreatitis, and hypertrophy of Brunner's glands must be excluded. When other segments of small bowel are involved the diagnosis can be made with relative ease.

The cases presented emphasize the importance of examination of the upper alimentary tract in patients with regional enteritis, as well as of the distal small bowel and colon.

Ten roentgenograms. NORMAN L. ARNETT, M.D.
Upland, Calif.

The Mucosal Pattern of the Mesenteric Small Intestine—an Anatomic Study. Robert D. Sloan. Am. J. Roentgenol. **77:** 651–669, April 1957. (Department of Radiology, The University of Mississippi Medical Center, Jackson, Miss.)

The purpose of the article is to present the gross anatomic appearances of the small bowel and to correlate, in so far as it is possible, the anatomic and roentgenologic appearances of the mucosal patterns. The author studied autopsy specimens of the jejunum and ileum under three different conditions: first, showing varying degrees of natural distention; second, after artificial distention with formalin or barium; third, showing abrupt changes from a contracted to distended state.

In the contractile state there was considerable variation in mucosal patterns both in the jejunum and in the ileum. The degree of distention and the pattern produced were related. This could be shown grossly and by roentgenograms after a barium suspension was used to distend the loop. The effect of the distention was not only to stretch the folds across the diameter of the lumen, but also to increase the length of the segment.

The findings suggest that "many of the small intestinal mucosal patterns observed roentgenologically can be correlated primarily with the degree of distention of the intestine by intraluminal contents or the state of contraction of the intestine wall as a whole." It was not possible to reproduce all the patterns seen clinically, as, for example, the longitudinal folds in the ileum associated with peristalsis.

The study is notable for its many excellent photographs and roentgenograms showing examples of various patterns.

Forty-two roentgenograms; 15 photographs; 1 diagram. D. D. ROSENFELD, M.D.
Fontana, Calif.

Fluid Levels in Diverticula of the Small Intestine: A Radiological Sign Simulating Obstruction. Aksel Strömme. Brit. J. Radiol. **29:** 574–576, October 1956. (Hedmark Fylkessykehus, Elverum, Norway)

The text of this paper is brief, but illustrations are provided showing multiple air-fluid lines in the abdomen on erect or decubitus films due to trapping of air and fluid in diverticula that closely resemble the air-fluid lines associated with intestinal obstruction. Subsequent barium studies showed the fluid levels to be related to multiple diverticula. The author believes that this confusing radiographic sign is another reason why examination with a barium meal is indicated in patients suspected of acute obstruction of the small intestine.

Eight roentgenograms. JOHN W. WILSON, M.D.
Johnstown, Penna.

High Kilovoltage Method of Investigation of the Colon as a Routine Roentgenological Procedure. Fred K. Wietersen. Am. J. Roentgenol. **77:** 690–699, April 1957. (18700 Meyers Road, Detroit 35, Mich.)

The author quotes data which emphasize the importance of the radiologist in the detection of polypoid lesions of the colon. Fourteen per cent of persons over the age of forty are believed to have colonic polyps. In at least 20 per cent of these persons, the polyps are multiple. Twenty-five to thirty per cent of the polyps are located above the reach of the sigmoidoscope, and 10 to 40 per cent are malignant in varying degrees. The challenge to improve radiographic technic is apparent when one realizes that the largest number of malignant polyps are to be found in the group measuring 3 to 5 mm. (Burnikel and Schutte: Am. J. Surg. **88:** 378, 1954).

On the basis of 1,000 consecutive barium enema examinations, the author feels that high-voltage technic is an efficient method of finding polypoid lesions, not only as a routine procedure, but for special examination He uses a mixture of 16 oz. of IX barium with 96 oz. of water at 105° F., giving the enema after thorough purgation with castor oil. The technical factors are: 120 kv, 300 ma, use of a 16 to 1 grid.

There were detected in this series 31 polypoid lesions, of which 25 per cent were malignant. One of the smallest polyps detected by the author measured 4 × 5 × 8 mm. and was malignant. Size and configuration were not useful as an indication of malignancy. Only 26 per cent of these polyps caused rectal bleeding.

Seven roentgenograms. D. D. ROSENFELD, M.D.
Fontana, Calif.

Perforations of the Colon into the Free Peritoneal Cavity. R. Mosimann and J. Hofstetter. Schweiz. med. Wchnschr. **87:** 453–458, April 13, 1957. (In French) (Service universitaire de chirurgie de Lausanne, Lausanne, Switzerland)

In the surgical service of the University of Lausanne only 2 of 34 patients with perforation of the colon seen in 1932–44 survived; in 1944–55 17 of 40 such patients survived. Four categories of perforation were found: (1) traumatic perforation; (2) perforation of inflammatory lesions; (3) perforation of cancer; (4) perforation by distention.

Traumatic perforations may be treated, within six to twelve hours after injury, by primary suture. In older lesions, where peritonitis has set in, the bowel must be exteriorized and drainage instituted.

Inflammatory perforations, if caused by tuberculous or other ulcers, may be treated by suturing and drainage. In sigmoid diverticulitis the problem may be more complex due to extensive involvement of surrounding bowel loops. In some patients the bowel must be exteriorized and an abscess must be drained.

Perforations caused by cancer may pose great difficulty. Treatment of both the perforation and the cancer must be considered. If possible, the tumor should be extirpated.

Perforation by distention may be associated with stenosing carcinoma or cicatrizing stenosis. Here consideration must be given to the condition of the dilated bowel, the primary lesion, and the complicating peritonitis. If possible, the primary lesion is excised and the perforation is sutured, followed by drainage of the peritoneal cavity. In some patients decompression of the bowel by transverse colostomy may be necessary, followed by definitive surgery.

The onset of colonic perforation may be subtle or abrupt. A sign of great importance is the demonstration of pneumoperitoneum on roentgen examination.

Three roentgenograms; 1 photograph; 4 tables.

CHARLES M. NICE, JR., M.D., PH.D.
University of Minnesota

Filling Defect in the Colon. E. de Arzúa Zulaica. Rev. clín. españ. **64:** 110–112, Jan. 31, 1957. (In Spanish) (Bilbao, Spain)

Surgical exploration of 2 patients, each of whom had a palpable tumor overlying a filling defect of the transverse colon, demonstrable on barium enema study, proved that the cause was extrinsic pressure from an inflammatory mass related to previous operations (a Billroth II gastrectomy; an appendectomy, followed by repair of an incisional hernia and subsequent laparotomy for removal of a lost gauze sponge). In the presence of a surgical history (and even without), the possibility of inflammatory (pseudoneoplastic) origin should be included in the differential diagnosis of filling defects in the colon.

Four roentgenograms.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Further Observations on the Use of Dihydroxyphenylisatin in Barium Enemata. J. W. McLaren, J. B. King, and W. A. Copland. Brit. J. Radiol. **30:** 223–224, April 1957. (J. W. McL., St. Thomas' Hospital, London, S. E. 1, England)

The authors previously described (Brit. J. Radiol. **28:** 285, 1955. Abst. in Radiology **66:** 629, 1956) the use of Dihydroxyphenylisatin (Veripaque) in a colloidal barium solution for enema studies of the colon. This they introduced and evacuated through a large-bore tube. They had found observations of evacuation at fluoroscopy more rewarding than those made in the filling stage. After two additional years of experience they continued to feel that "the study of the contracting bowel enables one to diagnose carcinomata and other pathological lesions with greater confidence. . . ." They reiterate two points: (1) Since Dihydroxyphenylisatin exerts a direct irritant effect on the mucous membrane, the colon must be well cleansed, so that the necessary surface contact will be made. (2) The substance should be thoroughly dissolved and dispersed throughout the enema, preferably with the aid of an electric mixer.

HOWARD J. BARNHARD, M.D.
University of Arkansas Medical Center

Symptomatic Annular Pancreas in the Adult. Norman W. Drey. Ann. Int. Med. **46:** 750–772, April 1957. (634 North Grand Ave., Saint Louis 3, Mo.)

Cases of annular pancreas fall into the following classification: (1) neonatal; (2) pediatric; (3) adult (asymptomatic); (4) adult (symptomatic). The present report concerns itself with the last group. Sixty recorded cases have been collected from the world literature, and 2 additional examples are reported in detail. The preoperative diagnosis of annular pancreas was made in 14 of this series, including the author's 2 cases.

Annular pancreas produces varying degrees of obstruction of the descending duodenum. Atresia of the duodenal wall is an important factor in the neonatal and pediatric cases and is probably of congenital origin. In the adult cases, atresia is not so constantly encountered. The development of symptoms after childhood lends weight to the concept that this atresia is acquired. No satisfactory explanation for the development of obstruction relatively late in life can be given.

Peptic ulceration is as frequently associated with annular pancreas as is pancreatitis. In this series 16 cases of proved peptic ulceration were found. Four of the ulcers were gastric, 7 were duodenal (1 postbulbar), and in 1 patient both gastric and duodenal ulcers were found. These lesions do not contribute to an obstructive lesion at the point of the annulus.

Males are affected by annular pancreas approximately twice as frequently as females. The history is of great diagnostic importance. The physical findings contribute little. The cardinal complaints have been pain and vomiting. Of lesser frequency and importance are nausea, weight loss, belching, eructation, and anorexia. The duration of symptoms is variable, ranging from "acute" to as long as twenty-four years.

Nocturnal aggravation of pain and vomiting, though specifically mentioned in only 3 cases in addition to the author's 2, seems to be the most significant diagnostic clue. When one considers the recurrent nature of the symptoms, and an average duration of about five years, the lack of severe nutritional disturbances (weight loss, etc.) is also suggestive.

X-ray study of the upper gastrointestinal tract is the most valuable procedure in establishing the diagnosis. Fortunately, in the adult, obstruction is not complete and roentgen examination is almost always feasible. The clear-cut separation of adult from pediatric cases is important radiologically. Diagnostically the procedures and criteria are different. The "double bubble" sign, pathognomonic in the very young, is of no value in adult cases.

Changes commonly seen in any duodenal obstruction are encountered proximal to the annulus. These include dilatation, reverse peristalsis, and pyloric incompetency, with or without gastric dilatation. The signs vary with the degree of obstruction. At the level of the annulus the duodenum is retracted toward the head of the pancreas, and the notch-like pressure defect produced upon the outer border of the loop seldom exceeds 1 to 3 cm. in length. This defect is characterized by a smoothing or compression of underlying mucosa and an eccentric narrowing of the lumen. When the annulus is narrow the lumen tends to overhang each side. A large, complete ring sometimes causes symmetric constriction. Beyond the annulus the lumen may be normal or diminished.

Lesions most frequently confused with annular pancreas are neoplasms and postbulbar ulcer. Cholecystoduodenocolic bands involve the bulb area in congenita

obstruction; annular pancreas is distal to this area. In the right anterior oblique position, bands disappear, while this maneuver accentuates the findings from an annular pancreas. In the adult, congenital lesions such as diaphragms, aberrant vessels, and atresia give no difficulty. The most outstanding sign of malignant disease is destruction of the mucosa. A broad-based polyp can usually be distinguished by carefully observing peristalsis through the involved area. Inflammatory adhesions can cause a picture similar to that caused by annular pancreas, and may cause trouble in the differential diagnosis. Characteristic roentgen features are: medial displacement; mucosal effacement; bulging of the recesses on either side of the annular band; absence of spastic phenomena; an unchanging picture on repeated examination. The only satisfactory therapeutic approach to annular pancreas is surgical.

Four roentgenograms; 7 drawings; 2 tables.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Intrathoracic Accessory Lobe of the Liver. Eugene T. Hansbrough and Raymond J. Lipin. Ann. Surg. **145:** 564–567, April 1957. (VA Hospital, Little Rock, Ark.)

The authors report the occurrence of an accessory lobe of the liver in the right chest. This was discovered during the routine examination of a patient with ulcerative colitis. The admission chest film revealed a lobulated mass in the right costophrenic sulcus which could not otherwise be differentiated. Anterior, posterior, and lateral roentgenograms of the chest following pneumoperitoneum showed this to be located posteriorly and to be wholly above the diaphragm. The nature of the mass was determined at thoracotomy.

Two roentgenograms; 4 photographs.

Compartmental Disease of the Gall Bladder: Cholecystography. Sewell S. Gordon. Gastroenterology **32:** 750–755, April 1957. (St. Louis Park Medical Center, 4959 Excelsior Blvd., Minneapolis, Minn.)

Three cases are reported in which routine cholecystograms demonstrated a gallbladder normal proximally but having calcified stones with associated inflammatory changes distal to a stricture in the midportion. This alerts us to the possibility of nonopaque stones in a nonvisualized distal segment of a gallbladder.

Six roentgenograms; 2 photographs.

GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

Papilloma of the Gall Bladder. Raymond A. Gagliardi and Philip D. Gelbach. Gastroenterology **32:** 666–674, April 1957. (R. A. G., 15864 Rosemont, Detroit 23, Mich.)

In 292 consecutive cholecystectomies, 3 proved papillomas of the gallbladder were found. The previously reported incidence is 8.5 per cent. Conflicting terms for a "true" papilloma and for a reaction to chronic inflammatory change are discussed, with the suggestion that "papilloma" be reserved for the new growth and that this in turn be regarded as a possible premalignant lesion. The clinical symptomatology and roentgen diagnosis are discussed and illustrated with 3 case reports. Positional films with repeat study are necessary to establish the diagnosis.

Four roentgenograms; 1 photomicrograph.

GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

THE MUSCULOSKELETAL SYSTEM

Multiple Myelomatosis. A Review Based on 68 Patients. John R. Martin and Louis Johnson. Canad. M. A. J. **76:** 605–615, April 15, 1957. (Montreal General Hospital, Montreal, Quebec, Canada)

The authors outline the findings and course of multiple myelomatosis based on 68 cases from the Royal Victoria, Montreal General, and Queen Mary Veterans Hospitals, Montreal, and report 4 cases in detail. In all cases in this series, the clinical diagnosis was confirmed by sternal marrow aspiration biopsy or autopsy. Forty-four patients (65 per cent) were males. The majority were seen between the ages of forty and seventy, most often at the end of the sixth decade. Severe pain, usually lumbar, was the presenting symptom in 47 cases.

The radiologic manifestations of multiple myelomatosis consist of well demarcated osteolytic areas superimposed on a diffuse osteoporosis, but a similar picture has been encountered in carcinomatosis of the bones and in hyperparathyroidism. Diagnostic roentgen changes were present in the overwhelming majority of the authors' cases. Two patients showed a diffuse demineralization for one and two years respectively, but they were not followed during the final stages of their illness. The remaining patients with osteoporosis and those whose radiological appearance was normal were not followed long enough to warrant any deductions. Rarely the roentgen picture may be normal throughout the patient's illness, and a curious association of multiple myelomatosis with diffuse osteosclerosis has been observed. Skull roentgenograms were taken of 34 of the patients, and in only 3 was a normal skull picture associated with roentgen evidence of myelomatous lesions elsewhere in the skeleton. The laboratory findings are also given.

The average duration of life from the beginning of symptoms to death was 15.7 months, with 4.5 years as the longest time of survival. In multiple myelomatosis, the majority of patients die from a combination of factors. The present series illustrates the importance of chest infections and renal failure, either singly or together, in causing death. At least half of the patients who died from pneumonia had pathological fractures which severely hampered respirations and encouraged the stasis of bronchial secretions.

Ten tables.

So-Called Eosinophilic Granuloma of Bone. P. W. Davey, G. M. Martin, and C. F. Hyndman. Canad. M. A. J. **76:** 623–627, April 15, 1957. (Royal Alexandra Hospital, Edmonton, Alberta, Canada)

Six cases of inflammatory nonspecific reticuloendotheliosis are reported. In all of these the basic histopathologic picture was characteristic of those lesions designated in the literature as eosinophilic granuloma. In 4 cases the histologic picture was fairly uniform and the symptoms and initial roentgen picture were typical; subsequent roentgenograms showed complete healing. In 1 case, the lesions were multifocal but responded well to x-ray therapy. In the sixth case, multifocal lesions of bone with diabetes insipidus were present; the disease process in this case appears to be progressing.

Since Lichtenstein and Jaffe (Am. J. Path. **16:** 595, 1940) first coined the term "eosinophilic granuloma" of bone, there has been a continuous controversy in the literature concerning the pathogenesis of this and other

diseases of the reticuloendothelial system. Much of the confusion, particularly in regard to the group of inflammatory reticuloses, has been engendered by the marked variation in histological pattern which is seen from lesion to lesion, and also by the complete lack of any evidence of a specific etiological agent. The present authors believe that there is now enough evidence to warrant separation of the inflammatory from the neoplastic processes. In their opinion, it seems logical to suppose that the clinical pictures of eosinophilic granuloma, Hand-Schüller-Christian syndrome, and Letterer-Siwe syndrome are governed not only by the type of etiological agent, of which there are probably far more than the single agent designated by Lichtenstein as "X," but also by the part of the reticuloendothelial system involved. Because it is impossible to differentiate clinically between the disseminated forms of inflammatory reticuloendotheliosis and disseminated reticuloblastomatosis, the prognosis in this group of diseases should be guarded.

An abbreviated classification is presented in which these syndromes due to apparently different etiological factors have been related to the probable basic pathology.

Three roentgenograms; 2 photomicrographs.

Infantile Cortical Hyperostosis. Sylvester J. O'Connor and John C. Ivanoff. Ann. Surg. **145:** 573–579, April 1957. (Section of Orthopedics, University of Michigan, Ann Arbor, Mich.)

Infantile cortical hyperostosis has but few signs and symptoms. Hyperirritability, mild fever, and painful swellings over the face, thorax, and/or extremities predominate in the clinical history. The onset is usually at nine weeks; it has been observed roentgenographically as early as five weeks prenatally and as late as twenty months after birth. Remissions and exacerbations occur. The hyperirritability commonly precedes the swelling over bone, which appears suddenly in most cases. Fever is uncommon when the onset is in the immediate neonatal period. The clinical course may last from three to twenty months. Heredity seems to play no part in the etiology, although the syndrome has appeared in siblings at different times. No racial, sexual, economic, or geographic factors appear significant. No other specific etiologic relationship has been elicited.

The firm, brawny, very tender, diffuse swellings over bone are not accompanied by fluctuation, increased heat, reddening, or adenopathy. Pain and tenderness very often create pseudoparalysis in one or more extremities. Swellings may be multiple and asymmetrical; they most commonly occur in the mandible, clavicle, and ulna. Pleurisy may or may not be present when ribs are involved. The triad of pallor, painful pseudoparalysis, and pleurisy constitutes a helpful diagnostic aid. Residual osseous deformity may occasionally follow extensive involvement of bone.

Differential diagnosis includes parotitis, syphilis, scurvy, rickets, acute rheumatic fever, osteomyelitis, tuberculosis, poliomyelitis, meningitis, allergy, erythroblastic anemia, leukemia, trauma (*e.g.*, ossifying hematoma), nonspecific periosteal reaction, neoplasm of bone, Engelmann's disease and hypervitaminosis A.

The roentgen examination is of diagnostic importance. There occurs delayed radiographic evidence of subperiosteal new bone laid down both in areas of evident swelling and in apparently uninvolved regions. This may completely surround or "cloak" the diaphysis but never extends beyond the epiphyseal line. It may display an "onion-skin" appearance. The original cortex may undergo gradual and complete resorption, leading to an enlarged medullary cavity, thin cortices, and an appearance of osteoporosis. Complete resolution of the lesion is usually anticipated in from six to seventeen months, although regression has required as long as twenty-seven months. Late sequelae, consisting of radial and ulnar synostoses, anterior tibial bowing, and intercostal synostosis have been reported where original lesions were extensive. Roentgenographic lesions have now been reported in all bones but the spine, carpus, and tarsus.

Biopsy specimens reveal a grossly thickened, edematous, vascular periosteum which strips easily from bone, blends with the heavy fibrous tissue sheets in muscle overlying it, and sends thin fibrous bands through subcutaneous fat and connective tissues to the skin. Muscles appear pale, degenerative, and fibrotic. Bone appears grossly normal. The periosteum appears to be cellular but does not show changes induced by active hemorrhage or active inflammation. There is intimal proliferation in the arteries and arterioles of involved muscles. There has been noted a syncytium of large, pale osteoblasts lining the medullary surface of the outermost trabeculae. Lymphatic cells predominate in the bone marrow.

The disease in general pursues a favorable course, with little regard for the quality or quantity of therapy. Some seven deaths have been recorded in patients demonstrating this entity, at least one of which is directly attributed to it.

The diversity of opinion concerning etiology of the condition emphasizes the lack of understanding of the pathologic physiology involved. The recognition that constitutional symptoms and soft-tissue findings precede bony alteration has led to the logical supposition that the initial disturbance may lie in muscle or in blood vessels which in some way stimulate periosteal growth.

The authors add to the literature a case of scapular cortical hyperostosis in a two-month-old infant who recovered completely with no residual evidence of osseous abnormality.

Six roentgenograms, one photomicrograph.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Sequelae to Cold Injury in One Hundred Patients: Follow-Up Study Four Years After Occurrence of Cold Injury. Joseph R. Blair, Richard Schatzki, and Kenneth D. Orr. J.A.M.A. **163:** 1203–1208, April 6, 1957. (J. R. B., U. S. Army Medical Research Laboratory, Fort Knox, Ky.)

The authors have re-evaluated the condition of 97 patients (soldiers evacuated from Korea) previously studied for cold injury (Vinson and Schatzki: Radiology **63:** 685, 1954). Only 89 of these were actually re-examined, the others having been evaluated by questionnaire. Cold injury has been classified into four degrees of severity: first degree, hyperemia and edema; second degree, hyperemia with vesicle formation; third degree, necrosis of the skin and subcutaneous tissue; fourth degree, complete necrosis and loss of tissue. About 5,600 victims of cold injury were evacuated from Korea. Of the 97 former patients studied, 91 are gainfully employed, but more than half of them complain that they are handicapped by the residual effect of cold injury. Since monetary compensation from the

Veterans Administration is involved in many of these cases, the degree of psychogenic overlay in evaluating symptoms is difficult to determine. The most common symptoms are cold feet, pain, excessive sweating, numbness, abnormal color, and joint symptoms. All symptoms with the exception of excessive sweating, are much more severe during the winter months. Three patients with fourth-degree cold injury had lumbar sympathectomies, with considerable relief of pain, cold feet, and excessive sweating.

Physical examination revealed no tissue loss in second-degree cold injury. In third-degree injuries the tissue defect consisted of "punched-out" areas resulting from sloughing of the overlying eschar and subsequent granulation of the lesions. Actual tissue loss and loss of members was present in fourth-degree injury. In more than two-thirds of the cases of third-degree severity the toe nails were abnormal, being thickened, heavily ridged, and contracted at the front margin. The nail beds had an abnormal cyanotic appearance. As regards hyperhidrosis, one wonders whether it is a cause or effect of cold injury. A hyperhidrotic person is a likely candidate for cold injury and hyperhidrosis may have been present before the frostbite occurred and have been a major factor in causing it. Only 3 of 28 white patients examined showed abnormal color change, predominantly an erythrocyanotic appearance probably associated with peripheral circulatory disturbance. Skin depigmentation occurred in all Negroes with third- or fourth-degree frostbite. The incidence of stiff joints was well below the frequency of symptoms reported in the joints but greater than that of joint involvement shown by roentgenograms. Joint damage was more frequent and more extensive in the patients with more severe cold injury. In fourth-degree frostbites some of the stiffness of the joints may be due to heavy, contracted scar tissue around the joint rather than to a lesion within the joint itself.

Roentgenographic Changes: No changes in the bone were demonstrable roentgenographically immediately after frostbite. A mild or moderate osteoporosis, which was seen in a fairly large percentage of cases, may have been due to inactivity rather than to the low temperature. Mutilation of terminal phalanges could usually be traced to the loss of overlying soft tissues, exposure to air, and subsequent surgical removal of the exposed fragment. Only the most interesting roentgenographic changes were small "punched-out" defects, either of the surfaces of the joints or close to the surfaces of the joints of the hands and feet.

Roentgenographic studies on 89 of the original 100 patients four years after occurrence of the cold injury showed no late occurrence of osteoporosis. Coarsening of the trabeculae was seen in 12 cases, the changes resembling those seen in patients with changed statics. Terminal phalangeal defects were found more frequently in follow-up studies but were related to loss of overlying soft tissue rather than being due to direct cold injury to the bone itself.

Punched-out defects of the surfaces of the joints and toes and fingers were found in 19 cases. In 12 patients the changes were visible within the first twelve months after frostbite, some starting as early as the fifth month. The fifth toe was more frequently involved than the big toe, although in most cases of frostbite observed clinically the big toe is more commonly affected. An exact correlation between the degree of frostbite and the occurrence of lesions of the joints was not noted. Although no histologic studies are available, it is likely that joint changes represent subchondral defects filled probably with granulation tissue. Periosteal new bone formation, which was frequently encountered in frostbite produced experimentally, was seen in only 2 of the 100 patients. In both it occurred within the first two months and healed without visible residue. Since most of the patients that were studied were in the age group where the epiphyses are closed, no advanced disturbances of growth were seen except in one seventeen-year-old soldier in whom the open epiphysis of the fifth metatarsal apparently was involved by periosteal new bone formation with resultant deformity four years later.

Ten roentgenograms; 1 photograph; 5 tables.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Skeletal Lesions of Infantile Syphilis. B. B. Mukherji. J. Indian M. A. **28:** 355, April 16, 1957. (Sanctoria Hospital, Dishergarh, Burdwan (West Bengal), India)

A case of congenital syphilis in a nine-week-old Muslim infant with clinical and radiological evidence of involvement of the skeletal system as the only manifestation of the disease is reported. The patient was admitted to the hospital with multiple swellings of the ends of the long bones, of four weeks duration. Roentgen examination revealed areas of rarefaction of the medial and lateral sides of the lower end of the humerus; extensive rarefaction of the upper ends of the ulna and radius with a certain amount of periostitis of the lower third; submetaphyseal rarefaction of the lower ends of ulna and radius with a suggestion of osteomyelitis of the second metacarpal bone; medial and lateral areas of rarefaction at the lower end of the femur; destructive osteomyelitis of the upper and medial part of the tibia; submetaphyseal rarefaction at the lower ends of the tibia and fibula, more marked on the latter.

A diagnosis of infantile congenital syphilis was established in the patient and of latent syphilis in the mother and 2 siblings who did not show any clinical evidence of the disease.

Eight roentgenograms.

The Diagnosis of Hypertrophic Interstitial Polyneuritis by Myelography. N. A. Lewtas and Stevens Dimant. J. Fac. Radiologists **8:** 276–279, April 1957. (United Sheffield Hospitals, Sheffield, England)

The authors discuss the diagnosis of hypertrophic interstitial polyneuritis by myelography. This is a rare disease with a familial tendency. Its particular characteristic is thickening of the affected nerves but other changes in the extremities may occur consequent to a slowly progressing peripheral neuritis.

The essential pathology is a hyperplasia of the sheath of Schwann, which becomes increasingly widespread. These changes may affect only the spinal roots or the cauda equina, and a positive diagnosis by biopsy is therefore not possible. In such a case marked changes within the spinal canal may enable myelography to give the correct diagnosis.

Two cases are presented to illustrate this entity. In each of these there was a myelographic block at the level of the second and third lumbar vertebrae. In both cases there was difficulty in obtaining a free flow of cerebrospinal fluid at lumbar puncture, due to the partial obliteration of the subarachnoid space by the hyper

trophied nerve roots. In addition, where the total volume of the enlarged roots approximated the capacity of the lumbar theca, a myelographic block was caused which simulated a spinal cord tumor. Close scrutiny of the radiographs has shown the outline of the thickened nerve roots. Visibly enlarged nerve roots, and in particular their association with a myelographic block, should suggest the diagnosis of hypertrophic interstitial polyneuritis affecting the cauda equina.

Six roentgenograms; 2 photographs.

THEODORE E. KEATS, M.D.
University of Missouri

Chordoma—Uncommon Destructive Lesion of Cerebrospinal Axis. Charles M. Greenwald, Thomas F. Meaney, and C. Robert Hughes. J.A.M.A. **163:** 1240–1244, April 6, 1957. (C. M. G., 2020 E. 93rd St., Cleveland 6, Ohio)

Chordomas are tumors of low-grade malignancy due to neoplastic proliferation of remnants of the notochord, with a definite predilection for the extremes of the spinal axis. The great majority arise either in the basioccipital or sacrococcygeal regions. Vertebral lesions are particularly uncommon, accounting for only 15 per cent of all reported chordomas. The authors report 6 vertebral chordomas seen in a series of 8 chordomas in a five-year period. In the preceding twenty-eight-year period 12 chordomas were seen, none of which was vertebral in location.

Chordoma may arise anywhere along the primitive notochord from the buccopharyngeal membrane to the coccyx. There is slow expansile growth with destruction of bone and extension to adjacent structures. An extraosseous soft tissue component, variable as to degree, is an almost constant finding. Complete surgical removal is seldom possible because of the extension of the neoplasm to vital structures. Recurrence is the rule and radiation is of only palliative value, producing transient regression of the tumor and relief of pain.

Onset is insidious, with symptoms often measured in years rather than in months. In patients with cranial lesions the findings usually are those of brain tumor with increasing intracranial pressure. Patients with vertebral and caudal chordomas have backaches. There are no pathognomonic features either clinically or roentgenographically, and a high index of suspicion is necessary to make a preoperative diagnosis.

In the authors' series of vertebral chordomas 3 involved the body of L-3 and there was 1 each at the C-2 and C-4 levels. One was seen at T-11, the thoracic spine being by far the rarest site of this uncommon neoplasm.

Two of the 3 *lumbar chordomas* showed local erosion confined to the posterior portion of the body and some involvement of the pedicles. There was no collapse, and the intervertebral spaces were normal. The margin demarcating the destruction was sharply defined, as is common to slowly growing lesions. No reactive marginal sclerosis was present. The appearance is indistinguishable from that of a primary intraspinal tumor such as neurofibroma or meningioma. The third lumbar chordoma showed only equivocal bony changes posteriorly, but myelographic study revealed an elongated extradural defect producing an almost complete block. In this case the soft-tissue extraosseous component was responsible for the main findings.

The two *cervical lesions* were more extensive, with collapse and associated soft-tissue growth extending into the nasopharynx. Tumor can extend across the interspace to involve contiguous bodies but the disk space is relatively resistant, and total destruction of the disk, such as is seen in infection, is uncommon.

The authors' single *thoracic chordoma* was primarily diagnosed as tuberculosis because of the destructive bone lesion with an associated paravertebral mass. No disk space narrowing was present. The diagnosis of chordoma was established at autopsy. An unusual finding was metastasis to the lung and lymph nodes.

In no instance did the chordoma arise from the intervertebral disk. This is of interest, since the nucleus pulposus of the intervertebral disk normally is composed of residual notochordal tissue. Apparently only those vestiges that remain abnormally incorporated in a vertebra become the source of neoplastic growth.

The differential diagnosis encompasses all causes of vertebral destruction. There is no typical x-ray picture of vertebral chordoma. Although destruction usually is osteolytic, not even the presence of osteoblastic change will allow exclusion of chordoma. The more commonly seen cranial and caudal chordomas show a somewhat less variable roentgenographic appearance—a lobulated midline osteolytic defect with well defined margins. A feature of chordoma in all locations, but particularly the sacrococcygeal, is the striking extraosseous component that may be present, and anterior growth into the pelvis may suggest symptoms referable to any of the pelvic organs.

Cranial chordomas are second in frequency to the caudal group and account for 35 to 40 per cent of the total number reported. They arise from the region of the spheno-occipital synchondrosis. The basilar view of the skull is the most important in identification of the early lesion. Destruction of the middle fossa will be seen. With anterior growth, involvement of the sella turcica and parasellar structures often will be evident. Advanced lesions may involve the sphenoid sinus, the nasopharynx, the maxilla, and even the orbit. The soft-tissue component may extend intracranially. Posterior extension with involvement of the pons and medulla has been reported as the most common. Nasopharyngeal extension is occasionally seen.

Seven roentgenograms.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Paraplegia Caused by Unusual Extradural Granuloma Simulating Neoplasm: Presentation of a Case with Complete Recovery Following Surgical Removal. Robert W. Ard. Ann. Int. Med. **46:** 808–814, April 1957. (U. S. Veterans Hospital, Perry Point, Md.)

The author reports a case of paraplegia due to an extradural granuloma. A 33-year-old Negro male complained of weakness of both legs but was afebrile and in no acute distress. Positive findings included a wide-based shuffling gait, moderate flaccid paresis of both lower extremities, and questionable tenderness to direct percussion over the upper lumbar area in the midline. Neurologically, the vibratory and pain sensations in his legs were intact, light touch was questionably impaired, and deep tendon reflexes were slightly hyperactive on the left, normal on the right. No pathologic reflexes were found. Abdominal and cremasteric reflexes were equal and active, and no weakness of the rectus muscles was noted.

On admission there were a low normal white count

and an elevated total protein of 8.3 gm. per cent (4.7 albumin, 3.3 globulin). All other routine examinations were within normal limits. A spinal tap showed clear fluid under no increased pressure, with a negative unilateral Queckenstedt test.

Roentgenologically no abnormality of the thoracolumbar vertebrae was found, but a destructive lesion was noted in the right eleventh rib. On myelography a partial but almost complete block to the flow of contrast media was found at the level of T-11. Chest, hands, and skull were negative. A cord tumor was considered the most likely diagnosis.

A laminectomy was performed and a diffuse infiltrating lesion involving body and laminae of the eleventh thoracic vertebra was found encroaching extradurally against the spinal cord. This lesion was curetted to obtain a specimen and to decompress the cord. The tissue grossly had the appearance of carcinomatous metastases in bone. All of the tumor involving the vertebra and ribs was removed.

Six days after operation the patient was able to move both legs well, and his reflexes and sensation had again become normal. The pathologist reported that the tumor was not neoplastic but a chronic granuloma without caseation, caused by either tuberculosis or sarcoidosis.

At the time of this report, twenty months after operation, the patient remained symptom-free and without neurologic findings. Follow-up x-ray studies revealed no evidence of recurrent disease in the spine and ribs and no new lesions.

Two roentgenograms; 1 photomicrograph.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Differential Diagnosis of Ankylosing Spondylitis. James Sharp. Brit. M. J. **1:** 975–978, April 27, 1957. (University of Manchester Rheumatism Research Centre, Manchester Royal Infirmary, Manchester, England)

A study of over 500 patients attending a special clinic for the investigation and treatment of spondylitis indicated that approximately a fifth of these patients presented clinical or radiologic findings that were atypical for ankylosing spondylitis. These cases tended to follow an unusual clinical course and were not benefited by radiotherapy. The present report comprises a special study of such "atypical" cases with an attempt to differentiate them from the classical form. It was thought that these patients might actually be suffering from some other spinal disease which simulates ankylosing spondylitis. Among the conditions considered were rheumatoid arthritis, recurrent rheumatic fever, Reiter's disease, and psoriasis.

Rheumatoid Arthritis: Rheumatoid arthritis occurring in the spine characteristically involves the cervical region and usually does not show the sacroiliac involvement common to ankylosing spondylitis. Chest expansion is rarely reduced. Roentgenograms show gross narrowing of the intervertebral disk spaces with fusion of the margins of adjacent vertebral bodies and occasionally bony ankylosis of the apophyseal joints. "Bambooing" of the spine, or so-called "squaring of the vertebral bodies," which is characteristic of ankylosing spondylitis, is seldom seen with rheumatoid arthritis. Narrowing of multiple adjacent disk spaces without osteophytosis, and small infractions in the opposed vertebral bodies superimposed on a localized zone of sclerosed bone are helpful findings in rheumatoid arthritis. When the disease attacks the spine, it frequently has been present since childhood; narrowing or frank hypoplasia of the involved vertebrae may be present, a finding not seen in ankylosing spondylitis. Absence of osteophytosis is an important point.

Rheumatic Fever: Permanent joint changes in the spine resulting from rheumatic fever are rather rare. The patients are usually adults who have advanced valvular heart lesions and present a characteristic history of repeated attacks of severe and prolonged rheumatic fever, usually starting early in childhood. Roentgenograms of the limb joints seldom show bony erosions. In some cases large nodules will be present on the tendons. The most important differential point, however, is the history.

Reiter's Disease: The well known triad of nonspecific urethritis, inflammatory eye lesions, and arthritis may include arthritis of the spine and hence be confused with ankylosing spondylitis. Almost half of the patients with Reiter's syndrome showed involvement of the feet and knees, particularly with pain in the heels. In the relatively few patients who show involvement of the lumbar spine and sacroiliac joints, the roentgenographic appearances may be indistinguishable from ankylosing spondylitis. There is a striking tendency to proliferation of new bone at the affected sites. Ossification of the anterior longitudinal ligaments and the anterior disk margins, with preservation of the disks and without the "squaring" of the vertebral bodies, suggests Reiter's syndrome. The important differential points include the history and the predominant involvement of the feet and ankles.

Psoriasis with Arthritis: In the polyarthritis associated with psoriasis the hands or feet, usually both, are almost invariably involved, and the major changes are found at the distal interphalangeal joints of the fingers. When involvement of the spine occurs, the appearance on films is similar to that of rheumatoid arthritis, with a strong tendency to ossification of spinal ligaments. Involvement in the limb joints often produces a destructive type of arthritis but with less tendency toward proliferation of new bone. Differential diagnosis rests on the history, the finding of typical psoriatic lesions of the skin, and the overbalancing preponderance of changes in the limb joints.

A few of the "atypical ankylosing spondylitis" patients fell into less common disease groups, including "senile ankylosing hyperostosis," Paget's disease or other metabolic disease of bone, and heredofamilial calcinosis.

The roentgenograms included illustrate the points of the text very well despite their small size. The article contains many helpful differential points.

Fourteen roentgenograms, 1 photograph.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Double-Slot Exposures of the Spinal Column. W. Teschendorf. Röntgen-Blätter **10:** 21–27, January 1957. (In German) (Cologne, Germany)

Intervertebral spaces are difficult to demonstrate on routine roentgenograms, except for the interspace which lies in the projection of the central ray. Increase of the focal distance is of only limited help. This note describes a procedure which uses a lead plate with a 1.0-mm. slot, located as close as possible to the tube, and centered so that the slot corresponds to the central ray;

another lead plate, with a similarly centered and slightly larger slot, is placed between the patient and the Bucky. These two plates are connected to the tube and move with it; during the exposure, an electrical motor pulls the assembly (tube and plates) along a longitudinal track, corresponding to the patient's spine. For the lumbar spine, at 85-cm. target-skin distance, 105–125 kvp, and 60 ma (with reciprocating Bucky) the exposure time is five seconds; for the entire spine this is increased to nine to twelve seconds. Two reproductions of the spine (from C-5 to S-1 in the frontal, and from T-2 to L-4 in the lateral view) reveal excellent visualization of all interspaces.

Three roentgenograms, 2 drawings.

E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Eosinophilic Granuloma of the Femoral Shaft Simulating Ewing's Sarcoma. A. H. McKenzie and F. G. Day. J. Bone & Joint Surg. **39-A:** 408–413, April 1957. (A. H. McK., 8 Elmsley Rd., Liverpool 18, England)

The fallacy of complete reliance on x-ray evidence for the diagnosis of bone lesions was recently brought to the authors' attention by 2 cases of eosinophilic granuloma of bone which were believed typical of Ewing's tumor prior to biopsy. The patients were children of two and a half and three years.

Eosinophilic granuloma is a well localized, usually single, histologically distinct granuloma of unknown etiology which has its origin in the medullary cavity of a bone and tends to expand, with erosion and perforation of the cortex. Like Ewing's tumor, it occurs at an early age (under twenty) and it may produce the same symptoms (pain, tenderness, loss of function, and swelling). Roentgenographically, both Ewing's tumor and eosinophilic granuloma show rarefying lesions arising in the diaphyseal medullary cavity. With perforation, there is deposition of reactive new bone, which may show lamination, the so-called "onion skin" effect.

It is emphasized that single or multiple roentgenograms alone, or in combination with the clinical history, are not reliable indicators of benign or malignant growth. The serious effect of under-diagnosis of a malignant bone lesion is obvious. The serious effects of over-diagnosis of benign lesions should be equally clear if one considers the crippling effects of unnecessarily irradiated epiphyses or ablated limbs. The authors hope that their report will strengthen the growing belief that biopsy prior to treatment of bone lesions is mandatory even when the roentgenograms are "diagnostic."

Five roentgenograms; 2 photomicrographs.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

Osteogenic Sarcoma in the Hand. Robert E. Carroll. J. Bone & Joint Surg. **39-A:** 325–331, April 1957. (Memorial Center for Cancer and Allied Diseases, New York, N. Y.)

The author discusses osteogenic sarcoma of the hand, and reviews 10 cases of this very rare lesion, from various sources. All ages and both sexes were represented, with involvement about equally divided between the phalanges and the metacarpals. Swelling is usually seen long before pain begins. As far as can be determined, trauma plays no part in the etiology. This is of particular interest in view of the frequency with which the hand is subjected to trauma.

Two of the cases were irradiation-produced. In one, radium salts had been injected some twenty years previously; in the other, a dentist, there had been repeated exposure of the hand to roentgen rays. In 2 cases, the hand lesion was one of multifocal tumors. When this occurs, Paget's disease is usually found to be present, producing an altered bone metabolism. It is unusual for foci of metastatic osteogenic sarcoma to be found elsewhere than in the lungs before death. A metacarpal lesion was seen, however, in an eighteen-year-old male as one of several sarcomatous areas following osteogenic sarcoma of the femur.

In primary osteogenic sarcoma of the hand the survival rate is greater than the 10 to 20 per cent five-year figures set forth in the literature for osteogenic sarcoma in general. Local resection can be carried out as initial treatment with greater ease and safety than in the usual proximal sites. When previous surgical attempts have been made, the prognosis is less favorable.

Three roentgenograms; 4 photomicrographs; 2 photographs; 2 tables.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

Aneurysmal Bone Cyst of a Metatarsal: A Case Report. Robert J. Booher. J. Bone & Joint Surg. **39-A:** 435–440, April 1957. (139 E. 36th St., New York 16, N. Y.)

The author reports an aneurysmal bone cyst of the third metatarsal and discusses briefly the conflicting views concerning the pathogenesis of the lesion.

The patient, a 12-year-old girl, was followed with serial films for a cystic lesion of the distal diaphysis. This defect increased rapidly in size over a seven-month period to involve all but the base of the metatarsal. The bone was markedly expanded, with thinning of the cortex. A fine peripheral bony margin was preserved, however. The differential diagnosis included giant-cell tumor and fibrous dysplasia. An aneurysmal bone cyst was suggested on aspiration biopsy and that diagnosis was supported by examination of the resected bone.

The hands and feet are rare locations for this lesion. In retrospect, the author regrets the omission of arteriographic study. This might have been of unique value in observing the vascular background of the process, particularly in such a peripheral location.

Four roentgenograms; 2 photomicrographs; 2 photographs.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

Aseptic Osteonecrosis of the Posterior Epiphysis of the Calcaneus. G. Catolla Cavalcanti. Ann. radiol. diag. **30:** 1–9, 1957. (In Italian) (Istituto di Radiologia dell'Università di Torino, Turin, Italy)

Aseptic necrosis of the epiphysis of the os calcis (called in this paper Haglund-Sever-Blencke's disease, and classified among the "juvenile meta-epiphyseal dystrophies") appears between seven and fourteen years of age. In 4 cases of the 5 presented in this article, there was a history of previous trauma, in the fifth of repeated "micro-trauma."

The roentgenologic appearance varies with the stage. As a rule, the posterior ossification center of the calcaneus is fragmented and sclerotic, sometimes slightly flattened, separated from the rest of the bone by a radiolucent space (corresponding to the cartilage), which is very irregular and often larger than expected. Fragmentation may involve even the nucleus of ossification.

Densification is more or less pronounced, generally diffuse, though sometimes limited to the central portion of the ossification nucleus.

The 5 cases reported were seen by the author during one year, suggesting that the condition is probably much more common than had been previously suspected. Full recovery is the usual outcome.

Six roentgenograms. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

GYNECOLOGY AND OBSTETRICS

Aortography: The Safest Means of Placental Localization? A Preliminary Report. P. D. de Villiers and Donald Brink. South African M. J. **31:** 37–40, Jan. 12, 1957. (King Edward VIII Hospital, Durban, Union of South Africa)

An abstract of this paper appeared in RADIOLOGY for November 1957, page 780. The concluding sentence of the third paragraph of this abstract should be corrected to read: "The lateral position is preferred because it appears that the placenta usually develops on the anterior or posterior rather than on the lateral uterine walls, perhaps because it has a bilateral blood supply."

Our apologies to the authors of the paper and to our readers for our error. EDITOR

THE GENITOURINARY SYSTEM

Translumbar Aortography in Urologic Diagnosis: Limitations and Possible Pitfalls. Elliott C. Lasser and William J. Staubitz. J.A.M.A. **163:** 1325–1329, April 13, 1957. (E. C. L., 230 Lothrop, Pittsburgh 13, Penna.)

Although translumbar aortography is a frequently helpful and important procedure, it must be recognized that the dangers and resulting morbidity are appreciable. Consequently, before any patient undergoes this procedure, the possible importance of information to be gained must be weighed against the possible adverse effects. Those purposes for which translumbar aortography may be particularly helpful include:

1. To determine the type of surgical approach to be used.
2. To substantiate or indicate the presence of a renal tumor in instances in which clinical findings suggest such a diagnosis but no deformity of the collecting system has been shown on pyelographic studies.
3. Occasionally to strengthen the impression that a known mass lesion is a benign cyst when surgical treatment would involve considerable risk to the patient.

Several of the more common pitfalls in diagnosis are discussed and demonstrated, and the limitations of the procedure are commented upon. The authors attempted to show what size a mass lesion of the kidney must attain before it can be reliably visualized by the aortographic method. Studies on kidney specimens injected with contrast material and filmed after a small mass lesion had been placed within the renal substance indicate that, at best, a lesion 3 cm. in diameter may be demonstrated.

Ordinarily renal cyst and primary tumor of the kidney can be reliably differentiated with a technically adequate aortographic study. However, in instances in which a renal tumor shows a great deal of central necrosis and in cases where thrombosis of a major tumor vessel has occurred, the radiographic appearance may closely mimic solitary benign cyst.

Nine roentgenograms. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Damage to the Spinal Cord During Translumbar Aortography. W. S. C. Hare. J. Fac. Radiologists **8:** 258–266, April 1957. (Department of Radiology, Royal Melbourne Hospital, Melbourne, Australia)

The author reports a case of damage to the spinal cord during translumbar aortography in which 45 c.c. of 70 per cent Urokon were used in an initial examination and followed by an additional injection of 32 c.c. On recovery from anesthesia, the patient complained of being paralyzed in the lower extremities and on examination a flaccid paraplegia was found, with absence of plantar and tendon reflexes. An episode of anuria following the examination yielded to treatment but evidence of an upper motor neurone lesion affecting the lower limbs developed. Incontinence of urine and feces was present and the absence of all forms of sensation, except deep pressure, persisted below the ninth thoracic dermatome. The patient died four months later from a retroperitoneal fibrosarcoma, and until the time of death the neurologic signs remained unchanged.

Histologic examination of the spinal cord demonstrated gross demyelination in the midthoracic region, affecting all tracts with the exception of a very small area about each posterior horn. In the upper thoracic region the ascending tracts of the cord were demyelinated, although in the posterior columns only the medially placed fibers of the fasciculus gracilis were affected. In the lower thoracic and lumbar regions demyelination affected only the descending tracts, particularly the pyramidal tracts in the lateral columns. It was thought that the most likely cause of the lesion in the midthoracic region was a chemotoxic effect of the contrast medium used.

The author feels that the complication is probably due either to ischemia or chemotoxic injury and presents the evidence for each theory. Ischemia of the cord probably results from occlusion of a segmental artery. Such a happening is occasionally unavoidable when the translumbar route is employed. A likely explanation is the traumatic occlusion of a segmental intercostal lumbar artery by the needle used in aortic puncture.

Chemotoxic damage, similar to that occurring in the brain, has become a problem with the recent tendency to rapid injection of larger volumes of highly concentrated media and the associated increased retrograde flow up the aorta. It is probably unwise to inject more than 20 c.c. of 70 per cent Urokon rapidly into the aorta; when a greater volume is employed, the concentration should be lowered. Because of the risk of a summation effect, the introduction of a large volume of medium should not be repeated at the one examination.

Until a less irritating substance is developed, the liability of the spinal-cord blood-vessels to damage will limit the concentration and volume of contrast medium which can be safely used in aortography.

Six figures, including 1 roentgenogram.
THEODORE E. KEATS, M.D.
University of Missouri

Comparative Study of Five Urographic Contrast Media. Merall Roth and Thomas A. Nicholson. J. Urol. **77:** 670–681, April 1957. (M. R., 14 via Chepparro Drive, San Rafael, Calif.)

Five excretory urographic contrast media —Diodrast, Urokon in three concentrations, and Hypaque—were used in rotation, in a period of a year, in 420 patients without selection. The two authors used different methods in evaluating the examinations but found that their mean values showed consistent correlation. Hypaque caused fewer side effects than Urokon 50 and 70 per cent, and produced the best results, chiefly because of better filling of the ureters. Presumably Urokon causes ureteral spasm. Curves comparing visibility with molar concentration and iodine content for Urokon 30, 50 and 70 per cent resemble a renal excretion curve. It appears that the tubular maximum and maximal urine concentration of Urokon occurs at least by the intravenous load for Urokon 30. Quantities above this increase diuresis and yield a decreasing diagnostic return. Visibility is dependent upon both density (iodine concentration in the urine) and filling of the upper urinary tract structures. On the basis of physical and chemical characteristics and clinical information now available, Miokon should give results similar to Hypaque.

The principal advance to date in the preparation of iodide media has been in increasing the number of iodine atoms in the molecule from two to three. Further progress will require synthesis of a compound with four iodine atoms in the molecule. It will not be achieved by increasing the concentrations.

Three graphs; 8 tables.

THEODORE E. KEATS, M.D.
University of Missouri

Renal and Osseous Manifestation of Tuberous Sclerosis: Case Report. R. E. Beck and R. Case Hammond. J. Urol. **77:** 578–582, April 1957. (Protestant Deaconess Hospital, Evansville, Ind.)

The authors present a case clinically typical of tuberous sclerosis and exhibiting interesting radiographic findings in bones and kidneys.

A 40-year-old white woman was admitted with right renal colic, hematuria, and burning and frequency of urination, of one week duration. She gave a history of convulsive seizures beginning at the age of eighteen months and ceasing after the age of fourteen years. At fourteen she began having migratory joint pains associated with a blowing systolic apical heart murmur, and a diagnosis of rheumatic heart disease was made. She stated that skin lesions over the bridge of the nose and cheeks had been present "as long as she could remember." Roentgen examination showed kidney masses, large in size and indistinct in outline with a peculiar reticulated pattern of density. This reticulated pattern consisted of areas of radiolucency with a fibrotic periphery. Pyelography demonstrated elongated major calyces and renal pelves with multiple rounded impressions on the collecting structures. Discrete areas of bone density were noted in the wings of the ilia and the bodies, spines, and transverse processes of the lumbar vertebrae. Skull films revealed several areas of calcification, most of which stereoscopically appeared to be within the skull bones themselves. The ribs and long bones were normal, and the chest radiograph was not remarkable.

The radiographic appearance of the kidneys in tuberous sclerosis is similar to that of polycystic kidneys. Indeed, pathologically some of the tumors of the kidneys prove to be cystic, though most are lipomas, hamartomas, myomas, or angiomas. The reticulated pattern noted in the kidney parenchyma may be due to the presence of a lipomatous component within the tumor and may be an aid in differentiation from polycystic kidneys.

The authors suggest that any patient with pyelograms consistent with the diagnosis of polycystic kidneys should be evaluated neurologically and, conversely, if abnormal skull densities or intracranial calcifications are identified, the kidneys should be investigated by pyelography. They feel that the inclusion of tuberous sclerosis as one of the so-called neurocutaneous syndromes is probably unjustified, in view of the frequency of involvement of tissues of mesenchymal origin.

Four roentgenograms; 1 photomicrograph; 1 photograph.

THEODORE E. KEATS, M.D.
University of Missouri

THE SPLEEN

Isolated Intrathoracic Displacement of the Spleen in Diaphragmatic Hernia. M. Rossetti. Schweiz. med. Wchnschr. **87:** 458–460, April 13, 1957. (In German) (Chirurgische Universitätsklinik Basel, Basel, Switzerland)

Displacement of the spleen into the thorax is usually found as part of a combined prolapse of the abdominal organs due to a large defect in the diaphragm. A case is presented in which a soft-tissue shadow was seen next to the stomach after contrast study. In another case the patient was operated on for a supposed tumor at the base of the left lung. The diaphragmatic hernia found at operation contained a normal spleen.

Four roentgenograms; 2 photographs.

CHARLES M. NICE, JR., M.D., PH.D.
University of Minnesota

MISCELLANEOUS

Studies on the Incidence and Duration of Postoperative Pneumoperitoneum. Isabella Harrison, Herman Litwer, and Walter H. Gerwig, Jr. Ann. Surg. **145:** 591–594, April 1957. (W. H. G., Jr., George Washington University Medical School, Washington 10, D. C.)

In an earlier study, one of the authors found that, of 37 patients who had undergone appendectomy, 25 showed some residual air with an average duration of three days and a range of zero to seven days. In 80 per cent all the air had been absorbed in four days. These were young military patients who were kept in bed until the seventh postoperative day. In a current study 104 consecutive postoperative patients were examined. All patients in whom the peritoneum was opened, including those undergoing inguinal herniorrhaphy, were included. Roentgenograms were taken in the upright and left lateral decubitus positions, beginning on the first postoperative day and continuing daily until all air was absorbed. An attempt was made to have the patient in each position for ten minutes before taking the film. When the amount of trapped air was small, it sometimes showed on only one of the films, indicating the importance of taking both upright and left lateral decubitus views.

The incidence of pneumoperitoneum was extremely low in the patients with inguinal herniorrhaphies. In the recent group of appendectomies the incidence was roughly 25 per cent in contrast to two earlier series, where it was 67 per cent and 77 per cent respectively. The actual duration of air in those in whom it occurred was lowered only slightly. For this reason it is difficult to ascribe the decreased incidence to early ambulation. The duration of pneumoperitoneum seemed in general to be directly proportional to its original volume, and not related to postoperative infection, ileus, or other factors. The asthenic individual with a relatively relaxed abdominal wall was subject to a higher incidence and duration of pneumoperitoneum. It also seems that the amount of trapped air was to a considerable extent dependent on the depth of anesthesia at the time the abdomen was closed. Those patients who were obese, markedly distended, or who were pressing during closure had a lower incidence. There appeared to be no correlation between either the duration or amount of pneumoperitoneum and pulmonary complications.

The authors conclude that postoperative pneumoperitoneum is absorbed within a two-week period in the majority of the cases. They also suggest that free air seen after the first two or three days in conjunction with signs of peritoneal irritation should still suggest either a ruptured hollow viscus or intra-abdominal abscess.

Two roentgenograms, two tables.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

TECHNIC

Improvement of Pneumoencephalography by High-Kilovoltage Technic. C. E. Buchheim, W. Frik, and J. Braunhofer. Röntgen-Blätter **10:** 65–72, March 1957. (In German) (Diagnostische Röntgenabteilung der Medizinischen Universitätsklinik Erlangen, Erlangen, Germany)

An increase in kilovoltage permits the reduction of roentgenographic exposure time because of (1) higher tube output at the higher kvp, (2) better penetration due to shorter wave length, and (3) proportionally more effective intensifying screens. At 100 cm. target-skin distance, with 7 : 1 grid ratio, regular film, fine-grain intensifying screens, and 120 kvp, the frontal view can be taken with 6 to 8 mas (corresponding at 100 ma to 0.06–0.08 sec.), the lateral view with 3 to 4 mas (*i.e.*, 0.03–0.04 sec.); at 150 kvp, the frontal view requires 3–4 mas (*i.e.*, 0.03–0.04 sec.), the lateral view 1.6–2.5 mas (*i.e.*, 0.016–0.025 sec.). The decrease in exposure time is advantageous in the examination of children and restless patients.

The higher penetration can obscure bone details or fine calcifications, and therefore preliminary routine roentgenograms with low-kilovoltage technic (up to 60 kvp) are necessary. During pneumoencephalography, however, the poorer visualization of skeletal parts because of high kilovoltage does not influence the much better identification of gas-containing structures. Therefore, the procedure will permit the use of small amounts of air in the case of very sick patients in whom the poor general condition would not allow insufflation of the usual quantity.

Four roentgenograms, 3 graphs, 1 table.

E. R. N. GRIGG, M.D.
Cook County Hospital

The Clinical Applications of Image Intensification. I. Cineradiography as a Routine Procedure. F. G. Greenwood. Brit. J. Radiol. **29:** 544–545, October 1956. (Hillingdon Hospital, Uxbridge, Middlesex, England)

II. The Cricopharyngeus in Radiography and Cineradiography. T. V. L. Crichlow. Brit. J. Radiol. **29:** 546–556, October 1956. (Royal National Throat, Nose and Ear Hospital, London, W. C. 1, England)

III. Cineangiocardiography. R. Astley and J. S. Oldham. Brit. J. Radiol. **29:** 556–560, October 1956. (Children's Hospital, Birmingham, England)

IV. Some Applications of Cinematography to the Radiology of the Oesophagus. J. Allcock and F. R. Berridge. Brit. J. Radiol **29:** 560–562, October 1956. (Addenbrooke's Hospital, Cambridge, England)

The four papers listed above constitute a symposium on the clinical applications of image intensification presented before the Annual Congress of the British Institute of Radiology. Greenwood considers cineradiography as a routine procedure. For this purpose, 35-mm. or 16-mm. film may be employed. To reduce the exposure to the patient, the fastest film available must be used. Fast film is necessarily coarse grained and this grain is less noticeable in the 35-mm. film. On the other hand, 16-mm. film is cheaper to buy and print and can be processed in standard developing tanks. The projection equipment for 16-mm. film is vastly cheaper. Whether the cineradiogram is viewed in the negative or positive is largely determined by personal preference. If viewed in the negative, the clear unexposed film around the centrally exposed circle must be masked.

If cineradiography is to be used routinely, it is imperative to develop some method of film processing in the department to avoid the delay of postal service and commercial film laboratory development. The author illustrates such a device, consisting of a rectangular framework on two sides of which are mounted two rows of bobbins grooved to allow free access of solutions to all parts of the films. This frame is supported on a base plate and hinged to the support to allow free rotation while the film is being wound on. Forty-five feet of film are taken up on the permanent bobbins and two detachable bars carrying larger bobbins are then fitted at each end to accommodate 55 feet of additional film. The loaded frame is then removed from the support and processed in standard developing tanks.

Crichlow considers radiography and cineradiography in relation to the cricopharyngeus. The cricopharyngeus muscle is composed of two parts: (1) an oblique, or pars obliqua, and (2) a transverse, or pars transversa. The oblique fibers arise from the cricoid cartilage and sweep posteriorly, superiorly, and medially to insert into the median raphe and through this raphe are eventually attached to the pharyngeal tubercle on the occipital bone. These fibers become a part of the pharyngeal pump propelling the bolus into the esophagus below. Where the oblique fibers overlap the transverse fibers there is a potential weak spot, the point where a Zenker's diverticulum may arise. The transverse fibers also arise from the cricoid cartilage and encircle the gullet to be inserted into the opposite side. Below, they blend with the circular muscles of the esophagus. The pars transversa is reponsible for closure of the mouth of the esophagus which the author has confirmed by radiographic study. As a bolus is about to pass, the transverse fibers open co-ordinately.

It has been observed by cineradiography that the mouth of the esophagus may fail to open or open a variable amount, and in these instances the cricopharyngeus may be visualized radiographically. The author has associated this finding with clinical symptoms referable to the cervical esophagus, namely, the sensation of "something sticking in the throat" or "a lump in the throat." An illustration is given which shows a posterior indentation on the post-cricoid area of the pharynx at the esophageal mouth due to contraction of the cricopharyngeus. In the *normal* subject the cricopharyngeus is *never* visualized. The author warns that the indentation of the posterior surface of the barium column may be produced by mechanisms other than incomplete opening of the cricopharyngeus. He has observed similar impressions produced by osteophytes from the spine, a swallowed foreign body and in cases of total laryngectomy with an "esophageal speech" (the cricopharyngeus becomes hypertrophied).

The degree of indentation of the cricopharyngeus is divided into four stages. The first stage is a shallow indentation with a point or dimple visible at the potential site of dehiscence. Stage II is a deeper indentation, tending toward a shelf-like projection. Stage III is a still deeper indentation, the anterior end of which may be enlarged and bulbous. The fourth stage is visible as an extremely deep indentation with a very narrow stream of barium usually outlined against an air-filled esophagus. The visualization of the cricopharyngeus may occur in all stages as the bolus is passing this area or immediately afterward. It is situated usually between the 5th and 7th cervical segments.

The author reports a series of 228 patients, with positive roentgen identification of the cricopharyngeus in 141. The causes of cricopharyngeus dysfunction (incomplete opening of the mouth of the esophagus) may include organic disease involving either the larynx or esophagus in the local area of the cricopharyngeus. Organic disease distant to the cricopharyngeus either in the esophagus or respiratory tract may also produce a neuromuscular dysfunction of the cricopharyngeus resulting in its roentgen visualization. Central or peripheral nerve abnormality, *e.g.*, bulbar palsy or laryngopharyngeal paralysis, may produce cricopharyngeus dysfunction and this abnormal mechanism has also been observed in blood diseases and vitamin deficiencies. The condition is seen most frequently without organic disease and is considered a neuromuscular disorder, the peak incidence of which is seen between forty and fifty and sixty and seventy years of age. It may occur in younger patients, as in cases of "globus hystericus."

The technical aspects of cineangiography are described by Astley and Oldham. The authors use intermittent radiation corresponding with the shutter opening on the cinecamera co-ordinated with the time that each frame of the cinefilm comes into the exposure position. A 16-mm. film is used; the image is photographed through an image intensifier, and a prism box with a secondary fluoroscent screen permits viewing while the photography is in progress. The contrast medium can be watched and the duration of exposure controlled. An analyzing projector is used for studying the cineangiocardiograms.

Cineangiocardiography has only two principal disadvantages, namely, the limited field size and the inferiority of definition compared with angiocardiography on full-sized films. In cyanotic heart disease not only has the cine method never failed to give information that the large film would provide, but it has made possible certain dynamic observations of the intracardiac and great vessel circulations that would not have been apparent by the conventional method. In noncyanotic heart disease, the difference is even greater, in that cineangiocardiography has permitted diagnoses that were not possible by the large film method. This has been especially true in the estimate of left-to-right shunts in atrial or ventricular septal defects and to a lesser extent in patent ductus arteriosus. The cine method has also made possible the study of valve function, particularly in eliciting the diagnosis of tricuspid insufficiency. It is reasoned that similar studies of the mitral valve may in the future permit a differentiation of predominant mitral incompetency and predominant mitral stenosis.

The future of cineangiocardiography will rely largely upon the improvements in the technical aspects of this method. Its application should greatly expand when intensifiers covering larger areas are available and when an improved definition of the image is developed.

Allcock and Berridge compare the role of cineradiography and conventional radiography of the esophagus. In the cervical esophagus, the movements are so rapid that cineradiography provides a distinct advantage over the conventional technic. The cine method insures a record of the esophagus in different stages of filling and eliminates the precise timing of single exposures. In the thoracic esophagus, cineradiography may offer a means of recording the rigidity of a segment of the esophagus and thus aid in distinguishing intrinsic from extrinsic lesions, which may not be done with accuracy by ordinary radiography. It also has application in determining the size of esophageal varices relative to intrathoracic pressure changes.

In the lower esophagus the use of cineradiography may elucidate abnormalities that cannot be clearly visualized even with an image amplifier. It also allows more accurate analysis of the movements of the lower esophagus (cardiospasm, etc.).

These papers are illustrated by roentgenograms, photographs and line drawings.

JOHN W. WILSON, M.D.
Johnstown, Penna.

Dark Adaptation and Aging of the Iris. Martin Weiser. Röntgen-Blätter **10:** 16–21, January 1957. (In German) (Schleiden, Germany)

Fluoroscopic visualization is determined by screen luminosity, width of the pupil, and adaptation of the retina.

The aging process reduces the maximum opening to which the pupil can dilate. At twenty years, the diameter is 4.7 mm. in daytime and 8 mm. at night, while the pupillary surface is 50 sq. mm. At forty years, these figures are 3.9, 6, and 30; at sixty years, they become 3.1, 4.1, and 14; at eighty, they are 2.3, 2.5, and 5. This would explain the insecurity of older people when forced to walk in the dark, as well as the comparatively lesser adaptation of the aging roentgenologist when compared with his young resident, even though they have the same length of time in the darkroom. The effect of pathologic processes, such as cataract or degenerative lesions of the macula, is not included in this comparison.

The adaptation of the retina could counterbalance the inability of the pupil to dilate, because it seems that, after twenty-five minutes in the dark, sensitivity

to light is about 80 per cent of what it will be after one hour; furthermore, after twenty-four hours in the dark, sensitivity is said to have been increased to 5.5 times that after one hour. Nevertheless, there is a physical limit to adaptation, considering that two photons of light must reach one cone within 0.1 second in order to register a sensation of light in the visual center.

Two tables. E. R. N. GRIGG, M.D.
Cook County Hospital, Chicago

Experimental Micro-Lymphangiography. Sven Bellman and Bo Odén. Acta radiol. **47:** 289–307, April 1957. (Serafimerlasarettet, Stockholm, Sweden)

For their experimental study of microlymphangiography, the authors used mature rabbits, injecting the contrast material into their ears and legs. Thorotrast and Umbradil were most frequently used. In a few experiments Micropaque was employed. Most of the experiments were done on living animals. Microangiograms were taken at varying intervals after injection.

The roentgen-ray equipment consisted of an AEG 50 T therapy tube with a beryllium window 1 mm. thick. The tube was energized by a full-wave rectified D.C. generator at ranges between 20 and 50 kv. Focus-to-film distance was from 23 to 53 cm.

The lymphangiograms were recorded on Agfa Printon Rapid Hochempfindlich film or Kodak MR plates. The developer used was Kodak D19b. The definition on the films permittted enlargement up to 10 or 15 diameters.

Experiments were carried out to determine the absorption of the contrast media. With 20 to 50 kv and varying concentrations of the contrast media, experimental microlymphangiograms of the same lymph vessels were taken in rapid succession. The object was to determine the effect of variations in voltage on the quality of the microlymphangiograms. A study of the movement of contrast media from the site of subcutaneous injection into the lymph vessels and away from them was also made.

The quality of lymphangiograms is significantly affected by the following factors: (1) the kilovoltage used, (2) geometrical conditions employed for image formation, (3) granularity of the photographic emulsion, and (4) scattered radiation and photo-electrons incident upon the film.

The contrast medium moved rapidly from the site of injection into the lymph vessels and was found in these as soon as microlymphangiograms could be made, about ten seconds after injection. By this time, the lymph vessels relatively remote from the site of injection were already filled. This phenomenon, the authors believe with good reason, indicates that the contrast medium is injected directly into the lymph vessels cut by the needle used for its injection.

When Thorotrast was used, good filling was obtained at an interval of ten seconds to three minutes. The vessels remained unchanged in appearance for eight or nine minutes. Complete disappearance of the medium occurred in forty-five minutes, the disappearance time being somewhat modified by the amount injected. Umbradil disappeared more rapidly than Thorotrast. Large numbers of lymph vessels could be demonstrated around the vascular supply of the anatomic part injected. Retrograde lymph flow was demonstrated.

The authors conclude that contrast medium reaches the lumen of the lymph vessels by direct injection and absorption. Soft x-rays must be used for the production of images, otherwise the quality is too poor for reproduction. Thin objects, such as rabbit ears, are ideally suited to this technic. Thick objects are less suitable. Present limitations confine the use of this procedure to small experimental animals.

The authors believe that the use of projection microradiography with an electronic image-amplifying device could make the application of microtomography possible. With such a development of the technic, it should be possible to apply it to investigations in man.

Eleven microlymphangiograms; 1 diagram; 5 graphs. H. C. JONES, M.D.
Grand Rapids, Mich.

Stain Historadiography. F. P. Bohatirchuk. Stain Technol. **32:** 67–74, March 1957. (Department of Anatomy, University of Ottawa, Ottawa, Canada)

The author has developed a technic for the study of bone tissue which he has named "stain historadiography." Fresh bone specimens are dehydrated in acetone and embedded in Ward's Bio-Plastic. Sections 10 to 15μ thick are cut with a special bone-cutting microtome and subjected first to radiography and then stained with safranin-fast green. The radiograph is made with a Machlett AEG-50-A x-ray tube on special plates or films coated with fine-grain emulsion. After processing, the historadiograph is mounted on a glass slide adjacent to the stained specimen in such a way that it is possible to find corresponding places in both under a microscope. With this technic, it is possible to make a correlated study of the calcium-bearing parts of the tissue and to determine accurately their relationship to the bone itself.

By means of stain historadiography, it is hoped that information may be obtained on the morphology of certain bone and cartilage elements which are converted from one to the other during bone growth. It may also be found useful in the study of bone resorption in osteoporosis or bone atrophy.

Three historadiographs; 3 photomicrographs; 1 photograph.

RADIOTHERAPY

Radiation Management of Apical Lung Tumors. Lewis L. Haas, Roger A. Harvey, and Charles F. Melchor. J. Thoracic Surg. **33:** 496–525, April 1957. (R. A. H., Department of Radiology, College of Medicine, University of Illinois, Chicago, Ill.)

The authors define an apical tumor as one which arises from the pulmonary apex (in its topographical sense as opposed to the anatomic apical segment), with an early tendency to extrapulmonary invasion. It is generally agreed that apical lung tumors do not form a separate pathological entity. Because of their particular peripheral location, however, their clinical and radiotherapeutic behavior differs from that of other lung cancers. Five stages are recognized: (1) pulmonary involvement only; (2) involvement of chest wall soft tissue, detectable only radiologically or surgically (no Horner's syn-

drome or bony destruction); (3) extension to bones; (4) paravertebral extension with Horner's syndrome; (5) regional and distant metastases.

A series of 18 cases is reported: 8 treated with conventional x-ray irradiation and 10 with 22.5-million-volt betatron x-rays. The tumor dose in the latter group was 8,000 to 11,000 betatron roentgens, delivered through four to eight portals, including the paravertebral and lateral vertebral region, with attempted avoidance of the spinal cord. The authors now believe a greater part of the vertebrae should be included, since recurrence took place in the paravertebral and cord areas.

In the betatron-treated group, 2 patients were living at eleven and twenty-seven months, while the average survival of the 8 who died was 19.6 months from the beginning of irradiation. For Stages 2–4, the average survival was 32.4 months; for Stage 5, only 6.7 months. Beta radiation far excelled conventional x-rays in therapeutic effect, both in the authors' series and as compared with results reported in the literature. Only in Stage 5 was survival not significantly prolonged, but even here good short-term palliation was achieved.

These better results are attributed to (*a*) higher tumor dose, (*b*) more homogeneous dose distribution, and (*c*) more accurate treatment planning, rather than any qualitatively different biological effect of the high-energy beam. The authors believe that improved results could be expected with conventional x-rays if similar care were exerted in treatment planning and technic.

The objective radiation effect could be followed by reduction or disappearance of the tumor, by recalcification of destroyed bony structures, gain in weight and strength, resumed or prolonged useful life, and disappearance or regression of the tumor in autopsy cases. Subjectively, there was disappearance or marked reduction in symptoms for a variable period and a significant reduction in the duration of the terminal stage.

This intensive treatment was not without late sequelae. The subcutaneous tissue of the supraclavicular fossa was replaced by woody-firm scar tissue after eighteen to twenty-four months, which sometimes later compressed the brachial vessels and nerves, causing pain, limitation of shoulder motion, circulatory disturbances, and paresthesia. In 2 cases late radiation mucositis of the esophagus resulted in moderate narrowing and dysphagia. No definite case of transverse myelitis was seen, although this proved difficult to evaluate due to similarity to metastatic spinal involvement.

The authors conclude that it is worthwhile to irradiate all apical tumors: in Stages 2–4 for significantly prolonged periods of useful life and possible cure, and in Stage 5 as a palliative aid for the remaining life of the patient. The diagnosis is rarely made in Stage 1, in which surgery would be academically the therapy of choice.

Thirty roentgenograms; 4 photographs; 10 tables.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

The Treatment of Cancer of the Female Urethra. Karl Wasserburger. Strahlentherapie **101:** 485–498, December 1956. (In German) (Sonderabteilung für Strahlentherapie im Krankenhaus der Stadt Wien-Lainz, Austria)

Primary cancer of the female urethra is rare, constituting less than 1 per cent of all cancers of the female genital organs. Fifty cases were seen in the Department of Radiation Therapy in the hospital with which the author is associated, from 1938 to 1951. Three groups are distinguished: Group 1, carcinoma of the external half of the urethra; Group 2, urethrovulvar growths; Group 3, carcinoma of the inner half of the urethra.

Treatment was as follows: for Group 1, a radium needle implant and irradiation of the outer half of the vagina by a vaginal radium applicator; Group 2, electrocoagulation followed by a radium needle implant and treatment of the outer half of the vagina by a vaginal radium applicator; Group 3, radium needle implant, irradiation of the bladder floor by a radium applicator, intrauterine radium application and external roentgen therapy. Depending on the size of the lesion, three to eight radium needles, 3 to 4.5 cm. long, were used, kept in place for seventy to one hundred and forty-four hours. The calculated tumor dose was 5,000 to 8,000 r.

Thirty per cent of all observed cases had regional lymph node involvement. These were routinely treated with a teleradium source to deliver a tumor dose of 4,000 to 6,000 r.

Forty-four of the 50 cases were treated adequately, with the following results:

Group 1 (24 cases): 22 symptom-free after five years.
Group 2 (20 cases): 8 symptom-free after five years.
Group 3 (6 cases): 3 symptom-free after five years.

The absolute five-year cure rate for all cases was 62 per cent; the relative rate, 70.5 per cent.

Four tables.

EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

RADIOISOTOPES

Interstitial Therapy with Radioactive Isotopes. Kurt Ernst Scheer. Strahlentherapie **102:** 506–510, April 1957. (In German) (Czerny-Krankenhaus für Strahlenbehandlung der Universität Heidelberg, Heidelberg, Germany)

For external irradiation of deep-seated lesions one needs powerful or complicated equipment in order to obtain optimal effect. Interstitial implantation of radioactive substances represents a much simpler method. Unfortunately, such a procedure is hazardous because protection of the operator cannot be entirely adequate. This unhappy situation, however, has changed for the better since radioactive isotopes have become available in the past four years.

Among the isotopes, Au^{198} has proved suitable because it emits gamma radiation of 0.41 MEV. Since its half-life is only 2.7 days, the isotope may remain in the tissues permanently. Two specific applications of radiogold are described and illustrated:

1. For pituitary irradiation small particles of activated gold wire are implanted directly into the gland. This is done by a transorbital approach alongside of the ethmoidal plate under image-amplifier control. The total dose amounts to 20 mc of Au^{198}. This form of treatment is used not only in pituitary neoplasms but also in cancer of the breast, so that stimulation of metastatic growth may be suppressed. The method has proved satisfactory in a series of over 50 cases, and no

radiation damage to the optic nerve has occurred, in contrast to the unfavorable experiences with radon seed implantation.

2. Another form of isotope application consists in infiltration of tumor tissue with a colloidal solution of Au^{198}. For pulmonary neoplasms and intrathoracic metastatic lesions, located peripherally, the solution is introduced endobronchially. A special syringe with ample lead protection is used, and the injection is done during withdrawal of the needle. The average dose amounts to 80 mc. Larger doses, especially over 120 mc, are apt to enter the circulation, thereby causing serious side-effects.

Since colloidal solutions are stored in the reticuloendothelial system, leukopenia, anemia, and thrombopenia are frequently observed. Therefore, the author has more recently used a carbon suspension of radiogold precipitate, instead.

Three roentgenograms. ERNEST KRAFT, M.D.
Northport, N. Y.

Thyroidal Accumulation of Radioiodine in Children. Glenn E. Sheline, Nina Koulischer, and Donald Pickering. J. Dis. Child. **93:** 391–395, April 1957. (University of California Medical Center, School of Medicine, San Francisco, Calif.)

The one- to twenty-four-hour thyroid uptake of I^{131} with a half-life of eight days was studied in 34 euthyroid, 16 primary hypothyroid, 16 secondary hypothyroid, and 17 hyperthyroid children. A scintillation counter was used, correction was made for background, and the uptake was expressed as a percentage of the administered dose. The percentage uptake was unrelated to the age of the patient.

The euthyroid group showed no evidence of thyroid dysfunction. The primary hypothyroid group presented evidence of this single glandular disorder, while the patients with secondary hypothyroidism not only had hypothyroidism but other stigmata of hypopituitarism, as sexual infantilism, low gonadotropins, low urinary 17-ketosteroids, diminutiveness, and x-ray evidence of sella turcica erosion due to brain tumor.

At twenty-four hours the average uptake by the thyroid in the euthyroid group was 22.1 per cent, with a range from 12 to 45 per cent. In the primary, nongoitrous, hypothyroid group, the average uptake at twenty-four hours was 4.9 per cent with a range from 2 to 12 per cent, while in the secondary hypothyroid group the average was 19.4 per cent and the range from 9 to 37 per cent. In the hyperthyroid group the uptake at both five hours and twenty-four hours proved significant. At the earlier hour the uptake averaged 63 per cent and at the end of a full day 66 per cent, with a range at the latter time from 48 to 79 per cent.

In the euthyroid group the average increase in I^{131} uptake following a dose of thyrotropic hormone was 11 per cent in contrast to only 2.2 per cent for the primary hypothyroid group. In the secondary hypothyroid group the administration of TSH (thyroid-stimulating hormone) effected an average increase in uptake of 9 per cent or more. This maneuver may then be considered in differentiating the two types.

While the thyroid uptake of I^{131} may be useful in differentiating between hyperthyroidism, euthyroidism, and primary hypothyroidism, it fails to separate the mild secondary hypothyroid from the euthyroid patient.

Five graphs; 2 tables. SAUL SCHEFF, M.D.
Boston, Mass.

The Thyroid-Stimulating Hormone (TSH) Test. An Aid to the Differential Diagnosis of Nontoxic Disease of the Thyroid. Penn G. Skillern and Burtis R. Evans. Arch. Int. Med. **99:** 234–244, February 1957. (Cleveland Clinic Foundation, Cleveland 6, Ohio)

Measurement of the thyroid uptake of radioactive iodine before and after intramuscular injection of 4 units of thyroid-stimulating hormone (TSH), thyrotropin, has been found useful in the differentiation of certain nontoxic thyroid diseases with and without goiter. The result of the test was regarded as normal when the I^{131} uptake after TSH was significantly greater than that before TSH.

All of 32 untreated patients with normal thyroid function and 25 of 29 patients taking desiccated thyroid had a significant increase in I^{131} uptake after the administration of TSH. In contrast, 17 untreated and 11 treated patients with primary hypothyroidism showed no such increase.

Although a single small dose of TSH produced a significant increase in I^{131} uptake in 7 of 11 patients with anterior pituitary failure without clinical hypothyroidism, several injections of larger doses of TSH were found necessary to differentiate secondary hypothyroidism from primary hypothyroidism. Even then the test is of only limited practical value for differentiating these two conditions.

The TSH test was abnormal in 30 of 31 patients with struma lymphomatosa, in contrast to a normal TSH test obtained in 31 patients with nontoxic adenomatous goiter and 6 patients with carcinoma of the thyroid.

No significant increase in I^{131} after TSH occurred in 12 of 14 patients with subacute thyroiditis and 5 euthyroid patients with surgically treated Graves' disease. The TSH test was normal in 6 of 7 euthyroid patients with radioiodine-treated Graves' disease and 4 of 6 euthyroid patients with untreated Graves' disease with exophthalmos.

The TSH test was found most useful in differentiating the euthyroid patient with questionable hypothyroidism from the patient with true mild to moderate primary hypothyroidism without goiter, the patient with normal thyroid function taking desiccated thyroid from the patient with true primary hypothyroidism taking desiccated thyroid, and the patient with struma lymphomatosa from one with nontoxic adenomatous goiter.

Four charts; 1 table.

Differential Diagnosis of Hypophyseal Myxedema and Primary Hypothyroidism by Radioactive Iodine and Phosphorus Tests. A. M. Ermans and P. A. Bastenie, with the technical assistance of M. Bruneel and A. Melis. Schweiz. med. Wchnschr. **87:** 339–341, April 6, 1957. (In French) (Clinique Médicale et Laboratoire d'Isotopes radioactifs de l'Hôpital St-Pierre, Université Libre de Bruxelles, Brussels, Belgium)

The necessity of including adrenal extracts or cortisone with thyroid extract in the treatment of hypophyseal myxedema makes differentiation of this condition from primary hypothyroidism essential. In some patients hypophyseal myxedema may be indicated by the absence of elevation of blood cholesterol, lowering of fasting blood sugar and 17-ketosteroid urinary excretion, exaggerated response to insulin, and the absence of a drop in eosinophil count during hypoglycemia. These findings, however, are not specific, and the results are inconstant.

In hypophyseal myxedema, radioactive iodine uptake

by the thyroid and radiophosphorus uptake by red blood cells do not return to normal following the administration of thyroid hormone alone, while in primary myxedema the reverse is true.

One figure; 2 tables.

CHARLES M. NICE, JR., M.D., PH.D.
University of Minnesota

Treatment of Hyperthyroidism with Individually Calculated Doses of I^{131}. Franz K. Bauer and William H. Blahd, with the assistance of Lucille E. Shoop. Arch. Int. Med. **99:** 194–201, February 1957. (F. K. B., 120 N. State St., Los Angeles 33, Calif.)

The results of treatment, using an individually calculated dose of I^{131}, in a series of 106 patients with hyperthyroidism are presented. One hundred four patients had diffuse glands; 2 had toxic nodules (these 2 patients were poor surgical risks because of severe cardiovascular complications).

The therapeutic dose of I^{131} was based on the roentgen equivalents to be delivered to the gland, the maximum per cent uptake by the thyroid of a tracer dose, the effective or observable half-life of the tracer dose, and the weight of the thyroid gland as calculated from the scintigram.

Following treatment employing this method of dosimetry, 100 (94 per cent) of the 106 patients became clinically euthyroid. Six became permanently hypothyroid, all following only one therapy dose of I^{131}. Fifty-six per cent of the patients required one therapy dose to become euthyroid; 32 per cent, two doses; 9 per cent, three doses, and 2 patients five and seven doses.

The effects of radioiodine therapy on the clinical signs and symptoms, as well as on the laboratory findings, with individually calculated doses, are reported.

The factors influencing the requirement for more than one therapy dose are discussed.

Two figures; 7 tables.

Histopathology of the Thyroid Gland of Sheep in Prolonged Administration of I^{131}. Sidney Marks, Norman L. Dockum, and Leo K. Bustad. Am. J. Path. **33:** 219–249, March-April 1957. (Radiological Sciences Department, General Electric Co., Richland, Wash.)

A study of the effects of the daily administration of I^{131} on sheep has been in progress for four years. A report has already been published on the biologic aspects of this investigation (Radiation Res. **6:** 380, 1957. Abst. in Radiology **70:** 151, 1958). In the present paper the authors describe the pathologic changes in the thyroid glands of sheep given I^{131} orally over a prolonged period. Levels of dosage employed ranged from 0.15 μc to 1,800 μc per day.

No pathologic effects were observed with a daily feeding level of 0.15 μc after a maximum period of four years. The principal early manifestations of thyroid damage were interfollicular fibrosis in adults receiving 5.0 μc daily and interfollicular edema in their offspring. Focal inflammation was the initial result from a daily dose of 480 μc. At feeding levels between 5.0 and 480 μc per day, various combinations of edema, inflammation, and fibrosis occurred. Prolonged administration of higher levels of I^{131} caused necrosis of follicles or infarcts. Progressive arterial damage was observed, including intimal thickening, changes in the internal elastic membrane, destruction of the smooth muscle of the media, and eventual obliteration of the lumina.

The pathologic changes observed involved the interstitial tissue, epithelium, and blood vessels. The effects on the interstitial tissue may be considered of primary significance in the early diagnosis of prolonged exposure to low levels of I^{131} in the species investigated.

Sixteen photomicrographs; 13 charts.

Transmission Dose Measurement for Cobalt 60 Radiation With Special Reference to Rotation Therapy. Sylvia O. Fedoruk and H. E. Johns. Brit. J. Radiol. **30:** 190–195, April 1957. (Saskatoon Cancer Clinic, Saskatoon, Saskatchewan, Canada)

In the treatment of tumors located in the thorax, the dosage error can be from 10 to 40 per cent when standard depth tables are used, because of the presence of air cavities and bony structures. Corrections can be made with the help of transmission dose measurements. When an ordinary ionization chamber is placed in the beam axis at a certain distance from the radiation exit point of the body, the measurement includes an unknown amount of scattering radiation. This unknown amount depends upon the thickness of the body, the location and size of air cavities and bony structures and the whole geometrical arrangement of the beam, the body, and the detector.

To avoid this uncertainty in the measurement, the authors have constructed an ionization chamber, which "sees" only the primary radiation. The arrangement consists of a lead plug with 71 holes pointing toward the center of the Co^{60} source which is 120 cm. from the front of the plug. Attached to the lead plug is an ionization chamber with a volume of 50 c.c. and with a thick lead shielding along the back and sides. Measurements with this focusing chamber show that the obtained transmission is practically independent of the distance between the radiation exit point of a water phantom and the ionization chamber. The percentage transmission as a function of the water depth is practically exponential. For a depth of 30 cm., there is only a difference of 2 per cent in the measured percentage transmissions between a 6 × 6-cm. and a 20 × 20-cm. field.

To show the practical use of their device, the authors give transmission tracings for patients (transmission as a function of rotation angle) undergoing rotation treatment for cancer of the lung. The transmission allows the calculation of the equivalent thickness of unit density material, which in turn makes it possible to find the tumor-air ratio. To convert directly from the measured transmission to the tumor-air ratio, for a point midway between the entrance and the exit points, the authors give a table for a number of square and rectangular fields.

Nine figures; 2 tables.

WALTER MAUDERLI, D.Sc.
University of Arkansas Medical Center

"Left Heart" Radiopotassium Dilution Curves in Patients with Rheumatic Mitral Valvular Disease. Hadley L. Conn, Jr., Donald F. Heiman, William S. Blakemore, Peter T. Kuo, and Stephen B. Langfeld. Circulation **15:** 532–539, April 1957. (University of Pennsylvania School of Medicine, Philadelphia, Penna.)

A rather complicated but apparently quite accurate method of differentiating between mitral stenosis and insufficiency is described. Catheters are placed in the aorta, left atrium, and left ventricle, and an indwelling needle in either a brachial or femoral artery. Pressures are recorded in the various chambers and radio-

potassium is then injected into the atrium, ventricle, and aorta consecutively. The radioactive content of the peripheral arterial blood is measured with a well-type scintillation counter and dilution curves are constructed for each injection. From these curves the circulation times from the various heart chambers, the cardiac output, and the amount of mixing of atrial and ventricular blood can be calculated.

Curves thus obtained for 9 patients with long-standing rheumatic valvular heart disease showed clear differences between "pure" stenosis (long circulation time from atrial injection, normal from ventricle and aorta; no mixing of atrial and ventricular blood) and "pure" insufficiency (normal aorta circulation time; slow from either atrium or ventricle; much mixing of atrial and ventricular blood). Mixed involvement gave intermediate curves.

After comparison of the results with all other means of differentiating mitral stenosis and insufficiency, the authors conclude that the pressure measurements and dilution curves provide an accurate estimate of the functional state of the mitral valve.

One figure; 1 table. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

A Metabolic Study Following Oral Calcium^{45} Administration in a Patient with Non-Tropical Sprue. Sidney Fink and Daniel Laszlo. Gastroenterology **32**: 689–703, April 1957. (Montefiore Hospital, New York, N. Y.)

A case of idiopathic steatorrhea (nontropical sprue) is presented in which metabolic balance and radioactive calcium studies were carried out. The patient received a single oral dose of Ca^{45} (59 μc, approximately 1 μc/kg. of body weight). The same amount of Ca^{45} was used from the stock solution as a standard.

During the first half of the study (thirty days) the patient received cortisone and was in remission. After thirty days, cortisone was discontinued and in the last week of the study there was a severe exacerbation of the disease.

It was found that despite his good clinical state and feeling of well-being the patient had active sprue even during cortisone therapy, with high fecal fat, nitrogen, water, electrolyte, and calcium losses. The high stool calcium was due to excessive endogenous fecal calcium losses. However, the utilization of ingested calcium administered as calcium gluconate was very high (79.5 per cent) and the calcium balances were positive. Following cortisone withdrawal the utilization decreased to 18 per cent, and the calcium balance became markedly negative in this period of exacerbation.

Negative calcium balance in sprue appears to be due to three factors: (1) an increase in the total digestive juice volume over the normal, so that large amounts of calcium are lost into the intestine; (2) poor reabsorption of digestive juice calcium; (3) poor absorption of dietary calcium. The data also suggest that cortisone improves the absorption of dietary calcium in sprue, whereas the endogenous fecal calcium is unaffected.

One figure; 3 tables. GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

Studies on the ^{59}Fe Uptake by Normoblasts and the Failure of X-Irradiation to Affect Uptake. H. D. Suit, L. G. Lajtha, R. Oliver, and F. Ellis. Brit. J. Haemat. **3**: 165–174, April 1957. (Department of Radiotherapy, Churchill Hospital, Oxford, England)

The uptake of Fe^{59} by human nucleated red cells *in vitro* and the failure of 300 to 5,000 r x-radiation *in vitro* to decrease this uptake has been reported (Brit. J. Haemat. **1**: 55, 1955. Abst. in Radiology **65**: 830, 1956). The authors describe an extension of these studies using the same technics for the *in vitro* culture of human bone marrow and high resolution autoradiography.

The pattern of uptake of Fe^{59} by human red cell precursors *in vitro* and rabbit red cell precursors *in vivo* was investigated. The basophilic and early polychromatic normoblasts were found to take up the isotope more rapidly than the late polychromatic normoblasts and reticulocytes.

Studies of the maturation process in rabbits with Fe^{59} indicated a life span of the order of twenty-four hours for the early normoblasts and suggested that a proportion of the reticulocytes are formed from early normoblasts without intervening cell division.

Irradiation with 100 to 5,000 r *in vitro* and *in vivo* did not appear to cause any direct inhibition of Fe^{59} uptake by the cells, although the rate of reticulocyte production was slightly diminished.

The significance of the findings is discussed.

Six charts; 4 tables.

Clearance Rates of Radiosodium from Myometrium. Patrick T. Moore and Philip R. Myerscough. J. Obst. & Gynaec. Brit. Emp. **64**: 207–214, April 1957. (Department of Obstetrics & Gynaecology, University of Edinburgh, Edinburgh, Scotland)

Observations were made of the clearance rate of radiosodium injected into the myometrium in 112 consecutive cases between the thirty-first and forty-third weeks of pregnancy. Of these, 5 had to be discarded as failures because either a blood vessel was entered or an anomalous curve was obtained. Twenty others were discarded because of the presence of abnormal conditions. Of the remaining 87 patients (50 primigravid, 27 parous), 40 were normal and 47 showed signs of pre-eclampsia.

A significant slowing of the clearance rate of Na^{24} was found in normal primigravidae past term.

There was a significant slowing of the clearance rate in pre-eclampsia. In cases of pre-eclampsia past term, there was an even more marked reduction in the clearance rate. In pre-eclampsia, clearance rates among younger women were slower than among older women. This is thought to be due to the inclusion of benign latent hypertensives in the latter group. The reverse was observed in normal pregnancy.

Among parous women the above differences were not clearly demonstrated, though the number of cases in the subgroups was small.

No correlation was found between clearance rates and the degree of hypertension or of albuminuria in pre-eclampsia, nor with placental weight or infants' birth weight in any group of cases.

The range of myometrial clearance rates observed, even in normal subjects, was quite large. This certainly limits the diagnostic value of the procedure, though results are reasonably reproducible in a single patient on separate occasions. But it is during a single test that changes in clearance rate most accurately reflect changes in blood flow. The authors are attempting to use this procedure to study the effects of drugs on myometrial blood flow.

Eight tables.

RADIATION EFFECTS

Roentgenographic Changes in the Lungs and Vertebrae Following Intense Rotation Roentgen Therapy of Esophageal Cancer. Karl-Eric Borgström and Inge Gynning. Acta radiol. **47:** 281–288, April 1957. (University Hospital, Lund, Sweden)

This paper is concerned with the frequency and appearance of radiation reactions in the lungs of 143 patients with esophageal neoplasms receiving rotational roentgen therapy between 1944 and 1952, at 170 kv filtered with 0.5 mm. Cu and 1 mm. Al. The width of the field was 5 to 6 cm. and the tumor dose varied from 6,000 to 6,500 r given in approximately thirty-five days The dosage was measured by Sievert's ionization chambers placed inside of the esophagus intermittently.

Thirty-eight of the patients had changes in the lung following irradiation of the esophagus. In only 3 of these were the changes seen during or immediately following the therapy; by four months they were demonstrable in 30 cases. The radiograph shows a central density which decreases peripherally and is usually present bilaterally at the level of the esophageal tumor. With the passage of time, some shrinkage of the lesion occurs. Symptoms are not marked, usually consisting only of a mild cough. Of the 19 patients surviving for three years or more, pulmonary fibrosis occurred in 10.

Vertebral lesions following the radiation were encountered in 13 patients, 10 of whom also had associated lung fibrosis. The abnormality consisted of osteoporosis with compression of the involved vertebrae. Only one case occurred within a year of treatment; in 3 cases changes did not appear until five to nine years after completion of the therapy. Symptomatology was extremely limited.

Although rotation therapy is apt to produce lung fibrosis and vertebral body changes, the associated morbidity is so slight that they are not considered contraindications for this form of therapy.

Three roentgenograms; 1 diagram; 1 table.

J. A. GUNN, M.D.
Grand Rapids, Mich.

Radiation Sialitis Following Radioiodine Therapy. A. W. G. Goolden, J. R. Mallard, and H. E. A. Farran. Brit. J. Radiol. **30:** 210–212, April 1957. (M. R. C. Radiotherapeutic Research Unit, Hammersmith Hospital, London, W. 12, England)

The authors report two cases of radiation sialitis following therapeutic doses of 100 and 150 mc of radioiodine. Attempts were made to estimate the radiation dose to the salivary glands by correlating the concentration in the plasma and the saliva following therapeutic and tracer doses of I^{131}. The calculated beta-ray dose to the salivary glands in both patients was approximately 700 rads. Some of the difficulties and potential sources of error in calculating the radiation dose to the salivary glands are discussed.

Three figures. W. R. SEIBOLD, M.D.
University of Arkansas Medical Center

Comparative Biologic Effects of 30 MeV_p and 220 kV_p Roentgen Rays and 0.4 MeV Gamma Rays at 8–9° C. K. C. Bora. Acta radiol. **47:** 321–326, April 1957. (Indian Cancer Research Centre, Bombay, India)

Microspores of *Tradescantia bracteata* were kept at constant low temperatures prior to and during irradiation to produce an initially uniform mitotic speed after the radiation. The radiation was done at uniform intensities and dosages with 220 kv and 30 MEV_p roentgen rays as well as 0.4 MEV_p gamma rays. Fixations were done at seventy-two and one hundred and thirty-seven hours after irradiation, when various types and percentages of chromosomal aberrations were determined.

There was found to be a difference in the time of appearance of aberrations with the gamma rays as compared to the roentgen rays, but the overall effect was not altered in either quality or quantity and this variation is therefore considered of no consequence from the therapeutic or genetic point of view.

Additional biologic evaluation of radiations will depend on more knowledge of the fundamental radiation effects on the biosynthetic processes.

One graph; 4 tables. J. A. GUNN, M.D.
Grand Rapids, Mich.

Dependence of Roentgen Injury to Rabbit Eye upon the Dose and Quality of Radiation. U. Ehling and E. Krokowski. Fortschr. a. d. Geb. d. Röntgenstrahlen **86:** 469–477, April 1957. (In German) (Spandauer Damm 130, Berlin-Charlottenburg, Germany)

Because cataract formation is the important complication of roentgen irradiation of the eye, an investigation to determine the quantity necessary to produce a cataract was undertaken. The maximum tolerable dose is still debatable, particularly since information on man is quite limited. For the purpose of this study, rabbits twenty-seven to thirty days of age were utilized. All were selected from a registered litter known to be resistant to ophthalmic changes and to have no hereditary tendency toward cataract formation. Rabbits of the age stated are more susceptible than adults and are considered to be comparable in susceptibility to the growing human eye. Differences in lens size and differences in scatter must be considered. The left eye only of each rabbit was irradiated and both eyes were examined with a slit lamp every three days.

Rabbit cataracts develop in three stages. The earliest noticeable alteration is punctate vacuole formation located toward the periphery of the lens posteriorly. The second stage is a striate clouding and this was considered the liminal formation truly representative of cataract. The third stage is total opacification. In no case did cataract formation, once started, regress, regardless of period of observation, age of the animal, quality or quantity of radiation.

With 1,250 rads and more, epilation of the eyelid developed. With 2,460 rads a reversible conjunctivitis appeared. There was also some irreversible corneal clouding which at no time became sufficient to interfere with the slit-lamp inspection of the lens. During the periods of observation, no eyeground changes of any type developed; there were no general reactions and no weight loss in association with the irradiation.

The general results indicate a greater susceptibility to cataract than previously suspected. There was no true quality dependence; apparent variations were seen to be due to actual variations in tissue dose. The latent period in days from administration of the radiation to the first appearance of a striate lens opacification was the basis for the comparisons. A single dose of 2,400 regenerated at 60 kvp, produced striate lens changes in twenty-five days; at 110 kvp the latent

period was eighteen days, and at 180 kvp the latent period was twenty-three days. The curve actually follows the tissue dose. This same dose of radiation ordinarily produces epilation in thirteen days, when generated at 60 kvp. The accepted epilation dose for a rabbit is 1,000 r as measured in air.

By charting the absorbed quantity of radiation and ignoring quality, the first lens changes are found to appear after a single dose of 350 r. With this dose the striate cataract develops in one hundred and fifty days. Below 350 r, no slit-lamp changes develop, regardless of the period of observation. As one increases the quantity of radiation, the latent period rapidly falls. From 750 to 2,500 r, there is a drop from one hundred days to fifteen days. Above 2,500 r the decrease is only slight. One can say that with the larger doses of radiation the latent period for an early cataract is two weeks. The fact that the latent period above 2,500 r drops so slightly indicates that this is the biologic time limit for response to the injury.

The extent of a cataract is also somewhat dependent upon the total quantity of radiation but is not dependent upon the quality. Under 1,000 r, regardless of wave length, one encounters only clouding in the posterior layer of the lens. From 1,000 to 2,000 r, various degrees of striate cataract develop. Above 2,000 r, total opacification takes place.

The authors did not completely investigate fractionation, but previous studies indicate that this prolongs the latent period within certain limits.

In view of the finding that a single dose of 350 r usually produces an early cataract in the rabbit, the authors recommend that for man 200 r be assumed as the single tissue dose above which some degree of cataract change may be expected.

Seven figures, including 3 roentgenograms; 2 tables.

WILLLAM F. WANGNER, M.D.
Royal Oak, Mich.

Comparative Mortality after 24-Hour, Whole-Body, Exposures of Mice to Fission Neutrons and Cobalt-60 Gamma-Rays. Howard H. Vogel, Jr., John W. Clark, and Donn L. Jordan. Radiation Res. **6:** 460–468, April 1957. (Division of Biological and Medical Research, Argonne National Laboratory, Lemont, Ill.)

An investigation was carried out of the effects of increasing the time of irradiation from one and a half to twenty-four hours in order to test the dose-rate dependence of fission neutrons and Co^{60} γ-rays. Nine hundred and twenty-six young adult female mice were irradiated for twenty-four hours in the gamma-neutron radiation chamber at Argonne National Laboratory. Thirty-day mortality curves were constructed after single whole-body exposures. Although the mice were without food and water for the twenty-four hour period and showed a significant decrease in body weight, no deaths occurred among 1,384 unirradiated controls during the thirty-day period after the test.

Comparisons were made between the probit regression lines (thirty-day mortality on dose) after exposure to each radiation for one and a half and twenty-four hours.

It was determined that dose rate played an important role after γ irradiation: The LD 50/30, which was 929 $\pm$ 5 r after ninety-minute exposures, was increased (43 per cent) to 1,324 $\pm$ 11 r after twenty-four-hour irradiation. The two γ probit regression lines were shown to be parallel.

Under the conditions of the present experiments, the mortality of mice exposed to fission neutrons seemed to be independent of the dose rate. The LD 50/30 was 210 rep, whether the time of exposure was one and a half or twenty-four hours.

With thirty-day mortality as a biological criterion, the relative biological effectiveness of the two radiations was determined to be 6.3 for the twenty-four-hour exposures as compared to 4.4 for the exposures of one and a half hours. This is considerably lower than the figure of 32 previously reported by others for comparable (twenty-four- and forty-eight-hour) exposures of mice.

The daily probability of death was calculated for comparable doses of the two radiations. The earlier mode of death after fission neutrons (with a peak around days four to ten) was apparent over the entire range of doses utilized.

The fact that mouse mortality after γ irradiation appeared to be dose-rate dependent, whereas that after exposure to fission neutrons (in the dose range studied) was independent of intensity, may aid in determining possible different mechanisms of mortality subsequent to these two radiations.

Three figures; 2 tables.

Modification of Radiation Response in Mice by Heterologous and Isologous Bone Marrow. L. J. Cole, J. G. Habermeyer, and P. C. Nowell. Am. J. Physiol. **188:** 555–558, March 1957. (U. S. Naval Radiological Defense Laboratory, San Francisco, Calif.)

A marrow transfer technic was used to study the functional state of the marrow of lethally x-irradiated mice after intravenous injection with isologous or heterologous (rat) marrow. It was found that the isologous marrow behaved as functionally active mouse marrow (in terms of radiation protection) at nineteen days postradiation, while it was essentially inactive at fourteen days although it appeared to be regenerated, as judged histologically. Mice irradiated with 800 r and injected intravenously with rat marrow exhibited "regenerating" marrow, but it was not active in preventing death when injected into other irradiated mice. Administration of rat bone marrow intraperitoneally to lethally irradiated mice failed to result in any fifteen-day survivals, even with 350 mg. or 700 mg. doses, per mouse. This latter dose is seventy times greater than the 10 mg. of isologous mouse marrow required to evoke 50 per cent survival.

Two graphs; 1 table.

The Effect of the Amount of Isologous Bone Marrow Injected on the Recovery of Hematopoietic Organs, Survival and Body Weight after Lethal Irradiation Injury in Mice. Paul Urso and C. C. Congdon. Blood **12:** 251–260, March 1957. (Oak Ridge National Laboratory, Oak Ridge, Tenn.)

The relation between the amount of isologous bone marrow injected into a lethally irradiated mouse and its thirty-day survival, the bone marrow response, the histology of the bone marrow in the left femur, the peripheral blood leukocyte count, the weight of the thymus, spleen, and body, and the appearance of the animal showed that quicker recovery of these end points occurred with increasing amounts of bone marrow administered.

The bone marrow parameter was the quickest to respond to the varying amounts of bone marrow injected. In addition, no optimum dose of bone marrow was found in these experiments for this end point. This

indicates that the bone marrow of an irradiated mouse could be made to show even quicker return to normal by injection of greater amounts of cells.

The peripheral blood leukocyte count and the spleen weight also showed quick recovery with the massive doses of bone marrow injected. For both end points, however, an optimum response was reached.

The results obtained from mice injected intravenously with a massive dose of bone marrow three days after irradiation indicated that the number of cells in the bone marrow of the right femur can be elevated within a few hours after injection. This could be observed, however, only in an irradiated animal where the number of cells in the right femoral bone marrow was already low. This finding gives further support to the hypothesis that intravenously injected bone marrow may become transplanted to bone marrow sites in the irradiated host.

Seven figures; 1 table.

Influence of Spleen Homogenate Injection on Post-irradiation Infection. Myron S. Silverman, Vivian Greenman, Marie Ellis, and Leonard J. Cole. Radiation Res. **6:** 474–482, April 1957. (U. S. Naval Radiological Defense Laboratory, San Francisco, Calif.)

The authors present data on the effects of injection of isologous spleen homogenate on the incidence of *natural* postirradiation infection. LAf_1 female mice from eleven to nineteen weeks old were irradiated in a single exposure with 790 r of x-rays, approximately an LD 100. Half of the irradiated animals were given a single intraperitoneal injection of spleen homogenate within three hours after exposure.

It was found that the injection of the spleen homogenate protected the irradiated animals from acute radiation death. The total mortality of the treated group was 21.2 per cent, whereas that of the untreated group was 91.5 per cent. This was accompanied by a decrease in the incidence of infection with the normal enteric bacteria during the first ten days postirradiation. Although the number of mice from which bacteria were isolated (primarily only from the spleen) increased during the latter portion of the second postirradiation week, there was no increase in the number of deaths. This suggests that with regeneration of the hematopoietic tissues sufficient recovery of the body defense mechanism against infection had occurred to enable the animals successfully to combat the invading organisms.

Two graphs; 3 tables.

The Occurrence of Mammary Tumors in the Rat after Sublethal Whole-Body Irradiation. C. J. Shellabarger, E. P. Cronkite, V. P. Bond, and S. W. Lippincott, with the technical assistance of W. A. Scott, M. Pavelec, and M. Canner. Radiation Res. **6:** 501–512, April 1957. (Medical Department, Brookhaven National Laboratory, Upton, N. Y.)

The experiment described here was designed to study the possible additive effects of β-radiation applied to small areas of the skin and of sublethal whole-body x- or γ-irradiation on cutaneous carcinogenesis. One hundred and ten female Sprague-Dawley rats, forty or forty-one days old, received whole-body irradiation, given as a single exposure, with and without β radiation to the skin of the back and were observed for eleven months postirradiation for the occurrence of mammary tumors. Fourteen nonirradiated rats of the same age served as controls. The β radiation was delivered by means of a Sr^{90} applicator at the rate of 37 rep/min; each rat received in three areas on the dorsum, immediately to the right of the midline, either 1,320 or 2,650 rep per area. Whole-body γ radiation was administered with a Co^{60} unit at a rate of 8.1 r/min., for a dose of 200 or 400 r. X-rays were delivered at the rate of 111 r/min., for a dose of 400 r.

The local β radiation was found to have no demonstrable effect on the occurrence of mammary tumors. One or more tumors developed in 56 per cent (27 of 48) of the rats exposed to 400 r of γ radiation, in 43 per cent (6 of 14) of the rats exposed to 400 r of x-rays, and in 31 (19 of 48) of the rats exposed to 200 r of γ-radiation. No tumors developed in 48 unexposed animals.

All tumors arising in the eleven-month period were mammary tumors, except one adamantinoma and one squamous-cell carcinoma of the skin of the ear. Seventy-six mammary tumors were observed in 48 whole-body irradiated rats, and the microscopic classification of these 76 tumors included: 43 adenofibromas, 20 adenocarcinomas, 5 fibroadenomas, 3 fibrosarcomas, and 5 not classified. Twelve of the 20 adenocarcinomas developed during the first four months after radiation; the appearance of all other tumors was randomly distributed during the period of observation. Many successive tumors were found in the same rat, and there seemed to be a positive correlation between the microscopic appearance of the initial tumor and the succeeding tumor(s).

Six figures; 1 table.

Modification of Acute Irradiation Injury in Rats by Dextran. H. Blondal. Brit. J. Radiol. **30:** 219–222, April 1957. (Department of Physiology and Medical Research, University of Manitoba, Winnipeg, Canada)

This report describes the beneficial effects of dextran on rats receiving midlethal doses of roentgen radiation. Evidence is presented that dextran lessens the severity of the irradiation-produced anemia and that it counteracts the second phase weight loss.

Inbred albino rats were treated in pairs in the same box. One of these received dextran and the other served as a control. Irradiation was given at 220 kv, with 1.55 mm. copper h.v.l., at a distance of 40 cm. Experiments were carried out to determine the lethality of a 600 r dose in animals receiving 0.5 ml. of dextran intraperitoneally per 100 grams of body weight. Dextran given either one hour before or one-half hour after irradiation produced a marked decrease in mortality, but with administration four hours after irradiation the effect was not statistically significant. Dextran did not alter the typical irradiation-produced leukopenia.

In contradistinction to other therapeutic procedures which increase the survival time by stimulating leukopoiesis and by stimulation of erythropoiesis, dextran appears to be beneficial because of an effect on the processes underlying the hemorrhagic phenomenon. The reticulocyte responses during the first three days after irradiation were the same for animals which were treated with dextran and for those not so treated.

Two figures; 2 tables. W. C. TALLEY, M.D.
University of Arkansas Medical Center

Effect of X-Irradiation on Myoglobin Content. Willard R. Faulkner and Frank R. Blood. Am. J. Physiol. **188:** 583–584, March 1957. (Vanderbilt University School of Medicine, Nashville, Tenn.)

An investigation was carried out to determine

whether a reduction in the concentration of myoglobin in the skeletal muscles occurs following an LD 50/30 dose of whole-body irradiation. Each irradiated rat was paired with a control animal. At approximately weekly intervals for five weeks, several pairs were killed and a portion of their skeletal muscle was assayed for myoglobin. No change in the myoglobin concentration was observed, although a severe anemia developed in all of the irradiated animals.

One table.

The Effects of X-Irradiation on the Fertilized Eggs of the Annelid, Chaetopterus. Catherine Henley and Donald P. Costello. Biol. Bull. **112**: 184–195, April 1957. (Marine Biological Laboratory, Woods Hole, Mass.)

Fertilized eggs of the polychaete annelid, *Chaetopterus pergamentaceus*, were irradiated with roentgen rays, beginning thirty minutes after insemination. The duration of treatment was one-half minute to eight minutes. The dosages employed were 255 r to 17,280 r; doses below 3,570 r were delivered at 510 r per minute and those above 3,570 r at 2,160 r per minute. Observations were made of both living and fixed eggs, at various intervals after irradiation, and of living trochophore larvae nineteen to twenty-two hours after irradiation.

The principal effects of relatively low doses (255–1,020 r) were found to be a slight retardation of cleavage (three to five minutes), and the production of abnormal trochophore larvae which were characterized by severe ciliary defects, cytoplasmic blebs, and very feeble movements (following doses of 255 to 765 r). Doses of 1,020 r and above resulted in death of most of the larvae by the trochophore stage. The majority of the eggs irradiated with 1,275 r and above showed at least a slight retardation of the first three cleavages.

Among the cytological abnormalities observed, especially after the higher doses, were multipolar spindles, chromosome fragmentation, and karyokinesis without cytokinesis.

One table.

Chemical Protection Against Enzymic Injury to Irradiated Mitochondria. Hedi Fritz-Niggli. Fortschr. a. d. Geb. d. Röntgenstrahlen **86**: 477–486, April 1957. (In German) (Radiotherapeutische Klinik des Kantonsspitals Zürich, Zürich, Switzerland)

Although the cell attracts the greatest attention, it must be kept in mind that important enzymes of the cytoplasm are very easily injured by radiation. Of particular interest are the enzymes involved in the Krebs cycle, the final common pathway of carbohydrate metabolism. Considering the entire Krebs citric acid cycle as activated by a cyclophorase, the interference with this cyclophorase activity as the result of irradiation was investigated for the following five transitions:

(1) The dehydration of succinic acid to fumaric acid.
(2) The oxidation of alpha-ketoglutamic acid to succinic acid.
(3) Transition of fumaric acid to malic acid.
(4) Change of oxalacetic acid to citric acid.
(5) The conversion of citric acid to glutamic acid.

The first preparation for the investigation of mitochondrial sensitivity consisted of the irradiation of homogenized liver cells, living and suspended in ice cold potassium chloride solution. The cells were obtained from a uniform strain of mice which had been fasted for fourteen hours prior to this study. Enzyme activity was tested by means of the Warburg apparatus immediately following irradiation. Kjeldahl nitrogens were also determined immediately.

This study revealed that homogenized whole liver cells are extremely resistant to irradiation, with succinodehydrogenase showing the least effect and citric acid breakdown the greatest. Moreover, it was only in livers of low nitrogen content that any effect could be demonstrated at all. Liver cells of high nitrogen content are resistant to up to 20,000 r of irradiation in so far as enzymes are concerned.

The mitochondria were then isolated by the centrifuge method as developed by Leuthardt. Irradiation was carried out with the same technic at 190 kvp. Adequate controls were maintained. Determinations were by the same method as with the whole liver cells. Isolated mitochondria were found to be extremely sensitive to irradiation. Utilizing numbers to indicate relative interference with the enzyme activity and the highest number being that showing the greatest interference by reason of irradiation, the small dose of 50 r yielded the following effects:

Succinate to fumarate	no effect
Citrate to alphaglucanate	10
Fumarate to malate	14
Alphaglucanate to succinate	24
Pyruvate to oxalacetate	33

Thus the breakdown of the pyruvate is greatly affected; its enzyme is the most sensitive to irradiation. There is no dependence whatsoever on the nitrogen content of the liver.

The differences in sensitivity between mitochondria and whole liver cells is apparently due to some protective substance in the liver itself. To gain a clue various chemicals were mixed with the mitochondria. With this technic, it was found that adenosinetriphosphate gave no protection. Related chemicals, on the other hand, gave great protection, particularly neohesperidin, rutin, and synkovite. It was also found that the carbohydrates, including that one used as the substrata, gave some protection. Protective carbohydrates include mannite, fructose, and mannose. These protective substances act only when mixed with the mitochondria at the time of irradiation. The only enzyme in the entire Krebs cycle demonstrated to be almost totally radioresistant is succinodehydrogenase.

Seven figures, including 1 photomicrograph; 3 tables.

WILLIAM F. WANGNER, M.D.
Royal Oak, Mich.